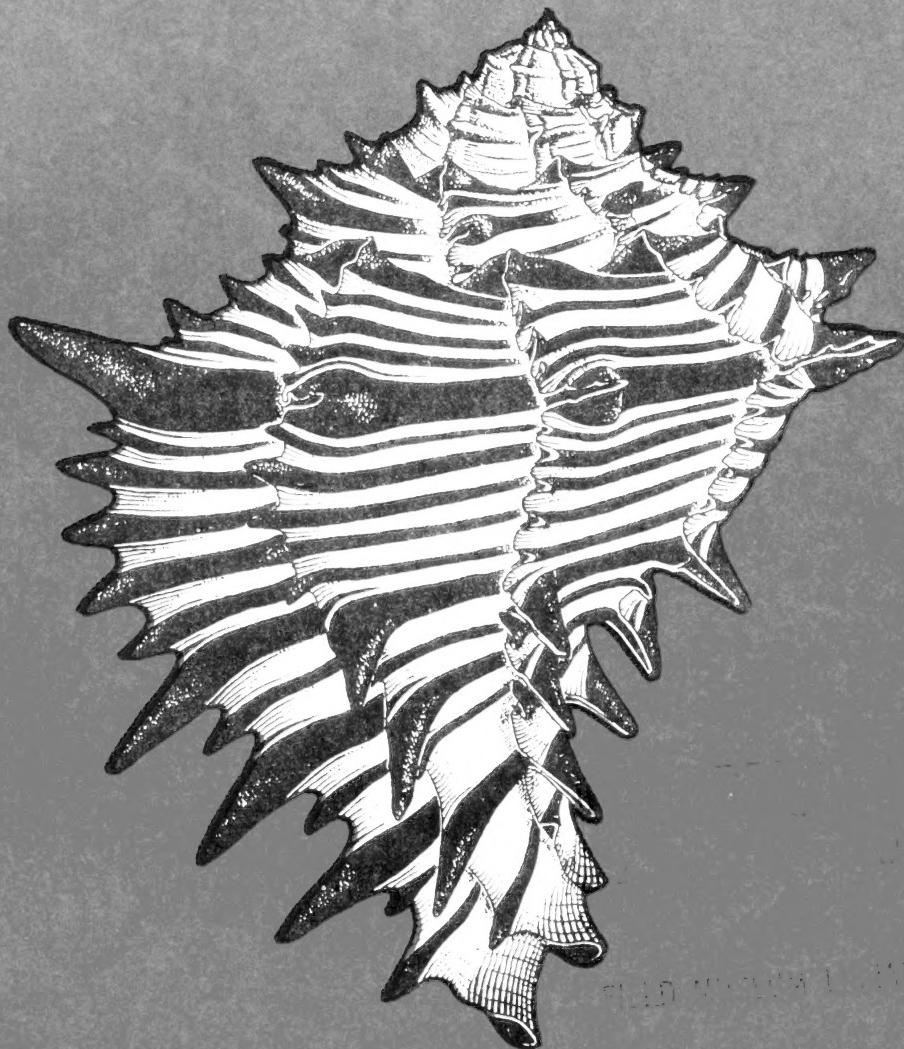


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NOTICE

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Overseas members are reminded that all monies due to the Society are payable in sterling.

THREE NEW SPECIES OF SOLEN (BIVALVIA: SOLENIDAE) FROM THE INDIAN OCEAN, WITH REMARKS ON THE SOLENIDAE OF MADAGASCAR

RUDO VON COSEL^{1,2}

(Accepted for publication, 20th May 1989)

Abstract: Three new species of *Solen* are described: *Solen crosnieri* n. sp. and *S. madagascariensis* n. sp. from Madagascar and *S. dactylus* n. sp. from the northern part of the Arabian Gulf, Iran and Pakistan. *S. crosnieri* is small, curved, with length/width ratio 5·8: 1, *S. madagascariensis* is medium-sized, straight, with length/width ratio 5·5: 1 and a conspicuously large distance between posterior adductor scar and pallial sinus. *S. dactylus* is large, straight, with length/width ratio 5·7: 1 and has a sharp furrow parallel to the anterior margin. The genus *Solen* in Madagascar comprises five species: besides the two new species *S. cylindraceus* Hanley, 1843), *S. roseomaculatus* Pilsbry, 1901 and *Solen*. sp. aff. *sloani* Gray in Hanley, 1842.

INTRODUCTION

The Solenidae of the Indopacific and specially of the Indian Ocean remain poorly known. No comprehensive publication on them exists since the taxonomic reviews of the whole group by Clessin (1888) and Sowerby (in Reeve 1874) and the accounts on Japanese and Chinese species by Habe (1964) and Tchang & Hwang (1964). Species of the Western Indian Ocean, the Red Sea or the Arabian Gulf are mentioned more or less briefly by Shopland (1902), Lamy (1909, 1928), Dautzenberg (1929), Moazzo (1939), Thomassin (1978), Ahmed (1975), Mastaller (1979) and Glayzer et al. (1984), without any illustration. In more popular books such as Kirtisinghe (1978), Smythe (1982), Bosch & Bosch (1982) a few are figured but often not correctly identified. In Morris (1986) no Solenidae are included at all. With this deficit in information on the family and also because of the difficulty in collecting Solenidae in general it is not astonishing that even large species remained undescribed until now. Sufficient material of three of them has finally become available to make it possible to describe them here.

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² Marine biologist at ORSTOM.

Abbreviations

BMNH: British Museum (Natural History), London, U.K.

CNRO: Centre National de Recherches Océanographiques, Nosy Be, Madagascar

IRSNB: Institut royal des Sciences Naturelles de Belgique, Brussels, Belgium

MNHN: Muséum National d'Histoire Naturelle, Paris, France

Natal Museum: Natal Museum, Pietermaritzburg, South Africa

NMW: National Museum of Wales, Cardiff, U.K.

SMF: Natur-Museum und Forschungs-Institut Senckenberg, Frankfurt/M, W-Germany

WAM: Western Australian Museum, Perth, W.A., Australia

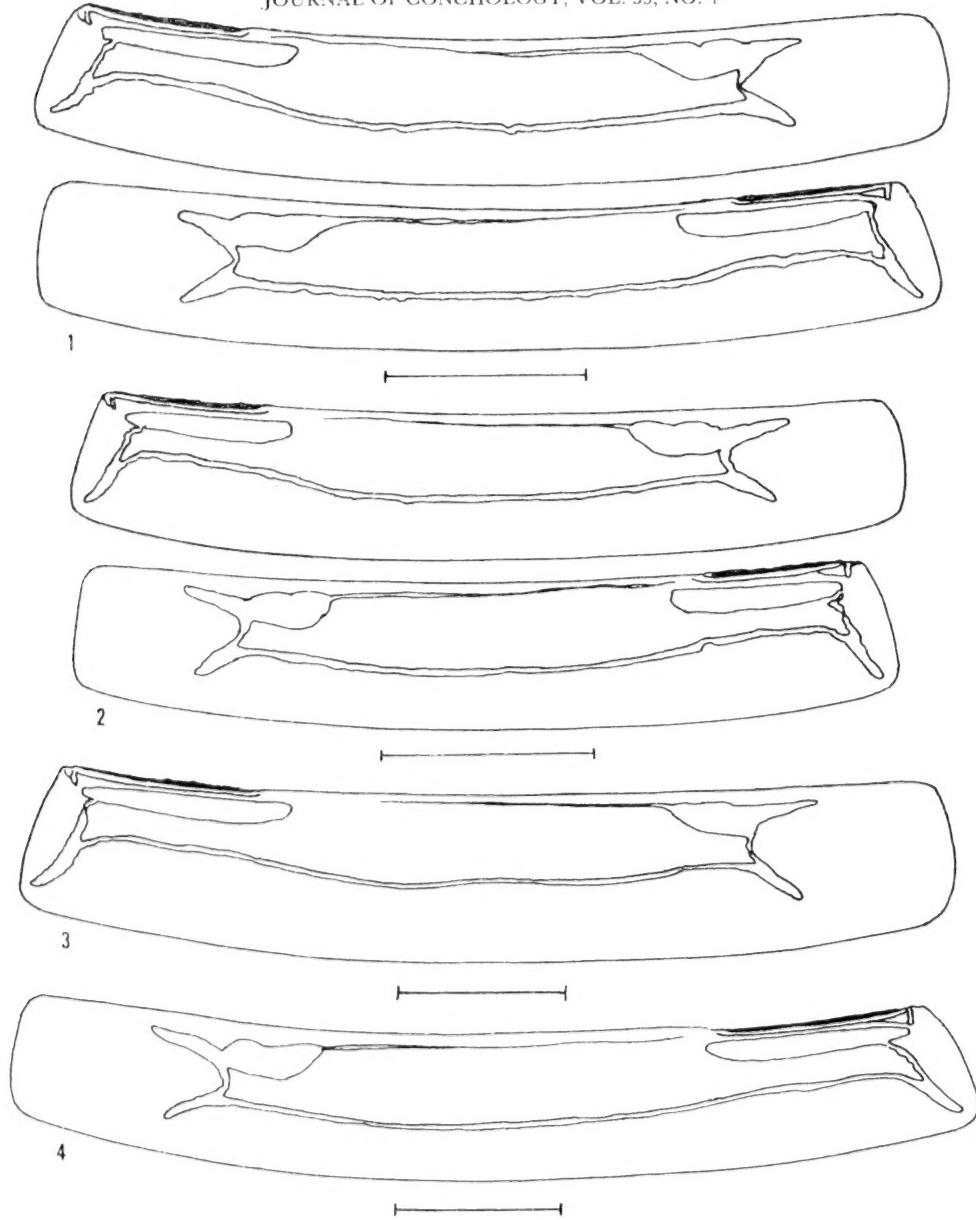


Fig. 1. *Solen crosnieri* n. sp. Holotype MNHN. Tuléar, Madagascar, sandbank just above low tide, XI. 1986, leg. von Cosel.

Fig. 2. *Solen crosnieri* n. sp. Paratype MNHN. Tuléar, same data.

Figs. 3-5. *Solen crosnieri* n. sp. Tuléar, thanatocoenosis S of harbour, 2 m, single valves, leg. von Cosel, MNHN.

Figs. 6-7. *Solen crosnieri* n. sp. Ambariahonka, W-coast of Nosy Be, Madagascar, on beach, 8. XII. 1986, leg. von Cosel, MNHN.

VON COSEL: SOLEN

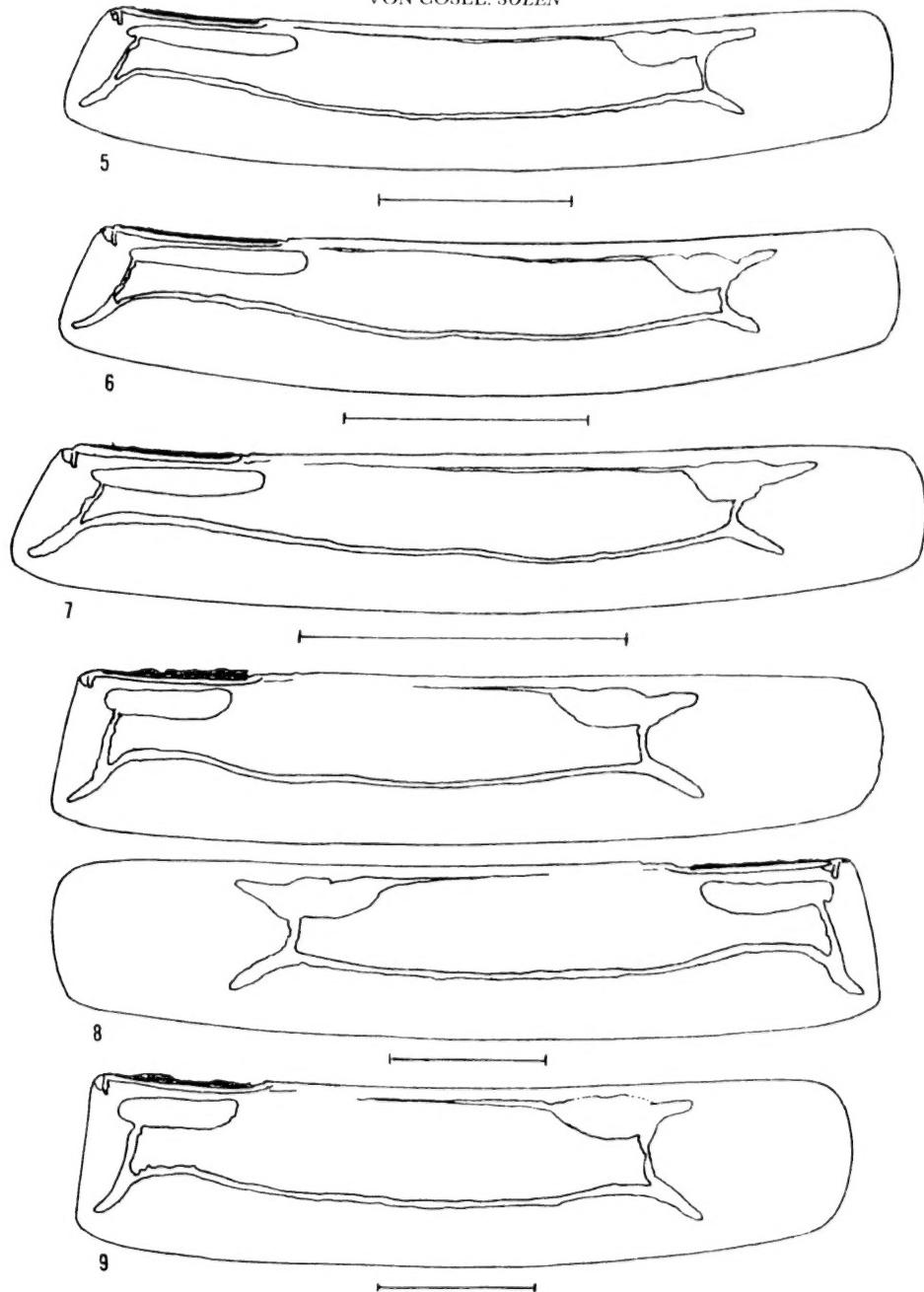


Fig. 8. *Solen woodwardi* Dunker, 1862. Measured syntype BMNH, Tacloban, Philippines, coll. Cuming.
Fig. 9. *Solen woodwardi* Dunker, 1862. 2nd Syntype BMNH.

Solen crosnieri n. sp.

(Figs. 1-7; Pl. 21, figs. 1-5)

Solen woodwardi Dunker (?)(sic!): Lamy, 1909, p. 346

Type material: Holotype MNHN, Tuléar, Madagascar, N of the street dam to the harbour, just above low tide, sandbank, fine clear sand, live collected, leg. von Cosel. Paratypes: same locality: 4 specimens, MNHN, 1 specimen, WAM 1 specimen, Natal Museum, all live collected, leg. von Cosel; same locality: 1 shell, 1 valve, SMF, 1 shell, 1 valve, CNRO, Nosy Be. SE of Tuléar harbour, thanatocoenose, sand 1-2 m: 3 valves, MNHN. SE of Pte. Anosy, Tuléar, tidal flats: 3 fresh shells, MNHN, all leg. von Cosel, XI. 1986.

Type locality: Tuléar, Madagascar, N of the harbour street dam.

Diagnosis: A small, thin, elongate and markedly curved *Solen* with parallel dorsal and ventral margins, rounded-truncated anterior and truncated posterior end, the posterior adductor scar connected with the pallial sinus, and without an external furrow parallel to the anterior margin.

Description: Shell small (to 58 mm long), thin, fragile and translucent, elongate, markedly curved, with length-width ratio 5·1: 1 to 6·3: 1 (mean: 5·76, n = 28) (see Table 1), with more

TABLE I SELECTED MEASUREMENTS OF SOLEN CROSNIERI (ALL TULÉAR)

length	width	ratio	
57·9	9·2 mm	6·3:1	(paratype MNHN)
55·8	10·1 mm	5·5:1	(paratype MNHN)
54·8	9·8 mm	5·6:1	(paratype MNHN)
53·6	9·5 mm	5·6:1	
52·1	9·1 mm	5·7:1	
50·0	9·8 mm	5·1:1	
50·0	8·4 mm	6·0:1	(paratype SMF)
48·0	8·4 mm	5·7:1	
47·9	9·0 mm	5·3:1	
47·8	8·0 mm	6·0:1	
46·5	7·7 mm	6·0:1	(holotype)
46·1	7·3 mm	6·3:1	(paratype SMF)
45·1	8·4 mm	5·4:1	
45·1	7·8 mm	5·8:1	(paratype MNHN)
45·0	7·6 mm	5·9:1	
45·0	7·4 mm	6·1:1	
44·9	7·8 mm	5·8:1	(paratype CNRO)
43·6	7·5 mm	5·8:1	
42·7	7·7 mm	5·5:1	(paratype CNRO)
42·7	7·6 mm	5·6:1	
40·6	6·5 mm	6·2:1	(paratype MNHN)
40·3	6·9 mm	5·8:1	(paratype WAM)
39·7	7·0 mm	5·7:1	(paratype Natal Museum)
39·5	7·1 mm	5·6:1	(paratype MNHN)
38·1	6·4 mm	6·0:1	(paratype MNHN)
36·2	6·3 mm	5·7:1	(paratype MNHN)
33·5	6·4 mm	5·2:1	(paratype MNHN)
25·8	4·3 mm	6·0:1	(paratype MNHN)

or less parallel margins. Dorsal margin usually concave, occasionally slightly concave, only very rarely straight, ventral margin conspicuously convex. Hinge and ligamental area slightly bent upwards. Anterior end obliquely truncated, faintly convex, with rounded antero-ventral corner. Anterior margin slightly thickened on the inside, on the outside no

furrow or depression parallel to it. Posterior end rounded-truncated, vertical or slightly oblique, with rounded corners, posterior margin slightly convex.

Anterior adductor scar long and narrow, about 1/4 to 1/8 longer than the ligament, straight and broadening towards posterior. Posterior adductor scar oval, directly before and connected with the pallial sinus. Ventral pallial line below the anterior adductor scar closer to the dorsal than to the ventral margin of the valve, then slightly descending and again gently rising towards the pallial sinus. Pallial sinus short and narrow, variable from triangular or rounded-triangular to trapezoid, with the innermost point mostly in the middle of the sinus. Distance between the innermost point of the pallial sinus and the posterior margin relative to the total length of the valves 1: 4·3 to 1: 5·2 (mean: 4·74, n = 20) (for explanations see Fig. 33).

Exterior smooth and glossy, with faint growth lines. Colour of valves creamy to light beige to pale yellowish brown. Periostracum thin and pale olive greenish.

Animal beige with a greyish-beige foot. Siphons darker greyish or greyish-beige with light beige transverse constrictions.

Distribution: So far only known from the west coast of Madagascar from Tuléar to Nosy Be. *Material examined:* the type material; Tuléar, SE of the port, 1–3 m, submarine shell concentrates (thanatocoenose) on sandy bottom, numerous valves; Tuléar, NW of the street dam to the port, sand, shell concentrates between tides, numerous valves, both leg. von Cosel, XI. 1986, MNHN; Tuléar Lagoon, 23°21'36"S, 43°38'12"E, muddy sand, 3·6 m, dredged, 1 valve, leg. Thomassin, 27. VIII. 1963; Mahavatse, 3 specimens, 1 valve, leg. F. Geay, 1905; Ambariahonka (Hotel Cocotier), SW–Nosy Be, on beach, several valves, leg. von Cosel, 8. XII. 1986, all MNHN; Orangea – Ambariahonka, SW–Nosy Be, 2 specimens, leg. M. Chavane, CNRO Nosy Be.

Habitat: The species lives in fine clean sand without mud, in sandbanks which are exposed for more than one hour during spring tides and which are not exposed at neap tides or only for some minutes. The species is not common, it is regularly present in its habitat, but in a very low population density. This habitat is subject to drying out during midday low tide exposure. At this time the animals try to bury deeper into the sediment but as the shell is curved, the burrow is also curved, and instead of really getting deeper into the sediment the razor shell takes a more and more horizontal direction and then upwards until it reaches the surface again about 70 to 90 cm away from its original upward position. In total, five specimens were collected partly or totally emerged from the sand with the extended foot forward. They were paralyzed by the sun and unable to rebury, but after having been placed in sea water they recovered quickly and started with burrowing movements again. The same happens in the biotope when the rising tide has reached them.

Derivatio nominis: The species is dedicated to my colleague A. Crosnier, to whom I owe the opportunity for field work in Madagascar.

Remarks: *Solen crosnieri* is most closely related to *S. lischkeanus* Dunker, 1861 (Figs. 10–12) from the northern part of the Red Sea and to *S. woodwardi* Dunker, 1861 (Figs. 8–9) from the Philippines. *S. lischkeanus* differs from the new species by the slightly different length-width ratio (4·3–5·2: 1, mean: 4·8, n = 9) and the more rounded posterior end. The anterior adductor scar is shorter and broader and very slightly longer or occasionally only as long as the ligament. The ratio distance of innermost point of the pallial sinus to posterior margin/total shell length is also different: 1: 3·4 to 1: 3·8 (mean: 3·6, n = 9).

The two species form an allopatric species pair with an extremely long distance between the two distribution ranges. Up to now *S. lischkeanus* is known only from the Gulf of Suez (material of Jousseau in MNHN, records of Moazzo (1939) and Issel (1869)) and seems to

be confined to that area. Mastaller (1978, 1979) did not find it either in the Gulf of Aquaba or in Port Sudan. It is not recorded by Sturany (1901) and Franc (1956), it is missing in the extensive mollusc material from Massaua, Djibouti and Aden collected by Jousseaume and others and preserved in MNHN, and it is not mentioned by Morris (1985). Moreover, there are no records of a species of this group from continental East Africa (Somalia to Moçambique). Although the type material of *S. lischkeanus* has not yet been found, the illustration in Dunker (1865) is quite exact and shows well the Red Sea species.

S. woodwardi Dunker, 1861, to which the new species had been tentatively identified by Lamy (1909), is also shorter and broader (length-width ratio 4·6: 1), and the anterior adductor scars are still shorter than in *S. lischkeanus*. It seems to be confined to the Philippines, but its exact range is not known. The illustrations (Figs. 8–9) show syntypes.

Solen madagascariensis n. sp.

(Figs. 16–19; Pl. 22, figs. 1–2; Pl. 23, figs. 1–2)

Type material: Holotype MNHN, Ambariahonka, SW-Nosy Be, Madagascar, leg. M. Chavane, 24. X. 1961, gift CNRO. Paratypes: same locality and date, 6 specimens, CNRO Nosy Be; Orangea, SW-Nosy Be, marée 0·2 m, 1 specimen, leg. M. Chavane, 17. III. 1976, MNHN; Ambatoloaka, SW-Nosy Be, fine sand, 2 m, 1 valve, leg. von Cosel, 8. XII. 1986, SMF; Tuléar, SW of port, on sand, shell concentrates at low tide, 1 juvenile valve, leg. von Cosel, 3. XI. 1986, WAM; Tuléar, directly NE of port, off the coastal navigation wharf, 3 m, fine sand, 1 valve, chipped and broken in two pieces, leg. von Cosel, 22. XI. 1986, Natal Museum.

Type locality: Ambariahonka, SW-Nosy Be, Madagascar.

Diagnosis: A medium-sized, elongate-rectangular straight *Solen* with very slightly diverging dorsal and ventral margins, with truncated anterior and posterior end, with the posterior adductor scar situated a considerable distance before the pallial sinus, with pinkish coloured growth zones and without an external furrow parallel to the anterior margin.

Description: Shell medium-sized (up to 105 mm), quite thin and translucent, elongate-rectangular, straight, with length-width ratio 5·2: 1 to 6·0: 1 (mean: 5·5: 1, n = 10) (see Table 2). Dorsal and ventral margin straight or very faintly convex, ventral margin more

TABLE 2 SELECTED MEASUREMENTS OF SOLEN MADAGASCARIENSIS

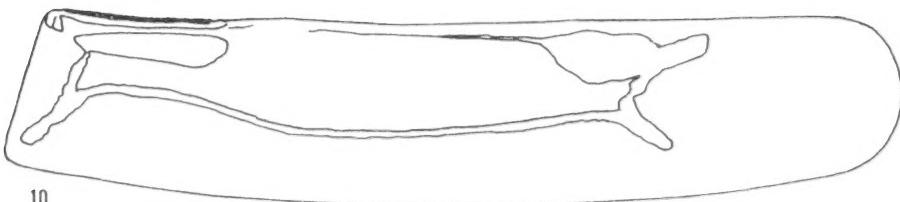
length	width	ratio	locality
105·3	18·7 mm	5·6:1	Nosy Be (paratype CNRO)
102·0	18·1 mm	5·6:1	Nosy Be (holotype MNHN)
93·7	15·5 mm	6·0:1	Nosy Be (paratype SMF)
92·2	16·7 mm	5·5:1	Nosy Be (paratype MNHN)
81·5	14·8 mm	5·5:1	Nosy Be (paratype CNRO)
71·3	12·7 mm	5·6:1	Nosy Be (paratype CNRO)
65·9	12·6 mm	5·2:1	Nosy Be (paratype CNRO)
52·0	9·3 mm	5·6:1	Nosy Be (paratype CNRO)
51·3	9·9 mm	5·2:1	Nosy Be (paratype CNRO)
34·0	6·2 mm	5·5:1	Tuléar (paratype WAM)

Figs. 10–11. *Solen lischkeanus* Dunker, 1865. Suez, Egypt, single valves, coll. Lefebvre, 1837, MNHN.

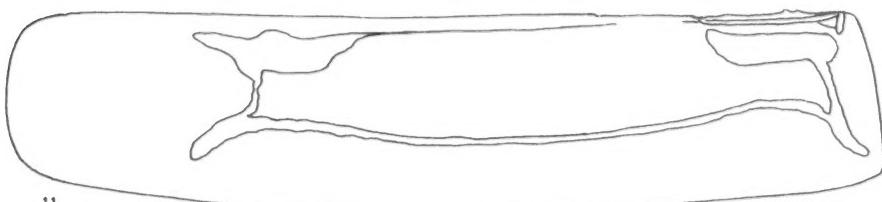
Fig. 12. *Solen lischkeanus* Dunker, 1865. Suez, single valve, coll. Jousseaume, 1921, MNHN.

Fig. 13. *Solen cylindraceus* Hanley, 1843. Tuléar, Madagascar, fine muddy sand, upper tidal zone, XI. 1986, leg. von Cosel, MNHN.

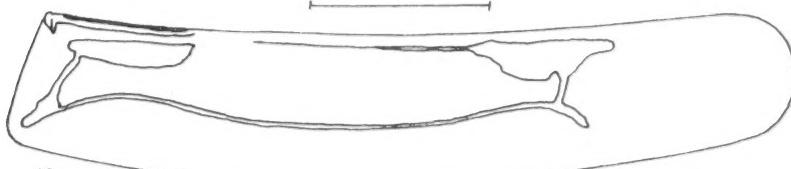
Fig. 14. *Solen* sp. aff. *S. sloani* Gray, 1842. Tuléar, dredged, dead shell, leg. Thomassin, MNHN.



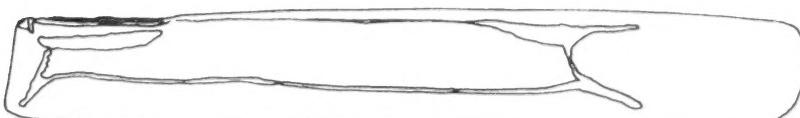
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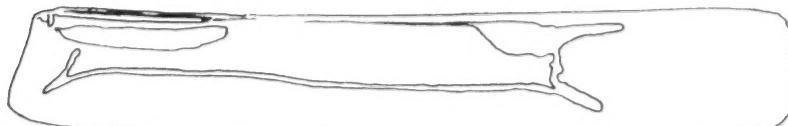
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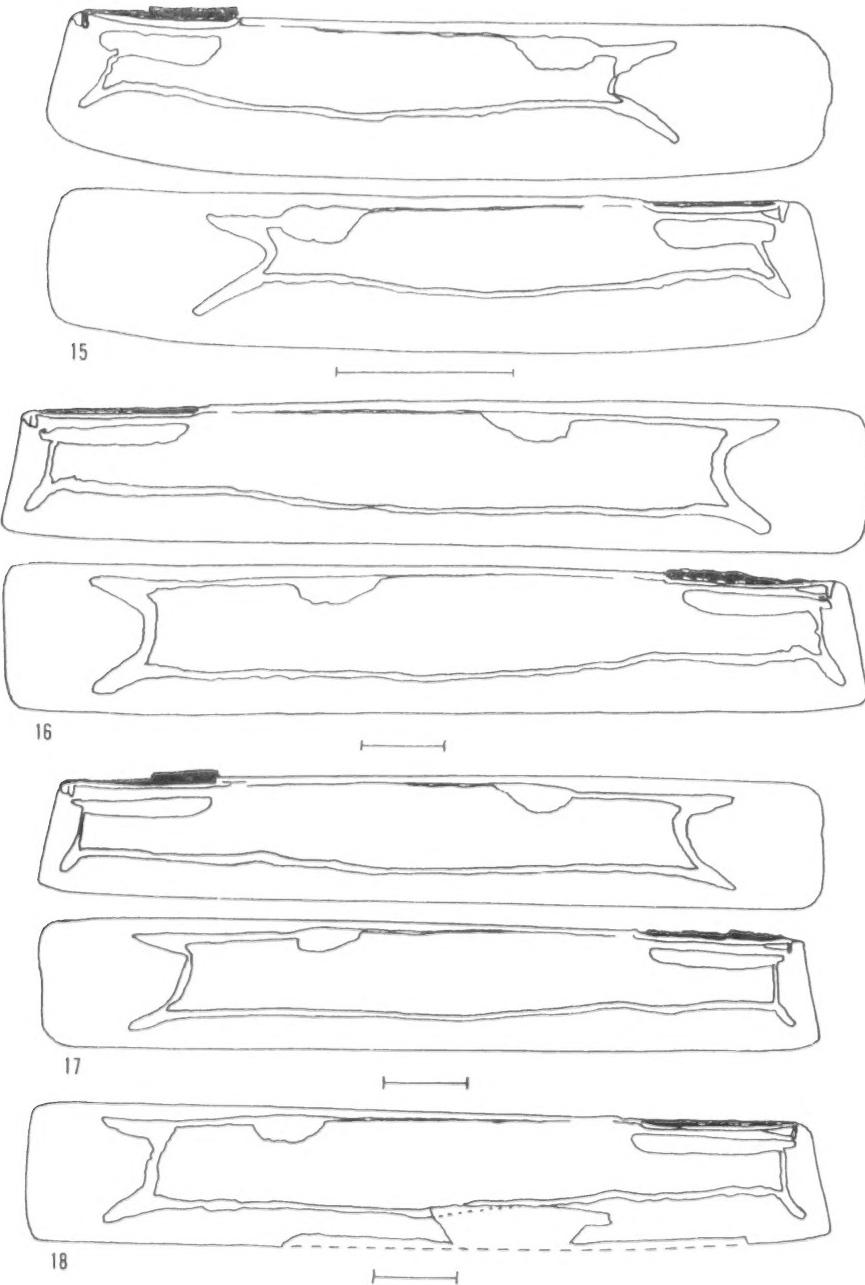
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convex in its first tenth just behind the anterior end. Hinge and ligamental area not bent upwards. Margins usually very slightly diverging so that the broadest part of the valves is situated at the posterior end. Anterior end obliquely truncated, anterior margin straight or very weakly concave, antero-ventral corner sharp. Inside of anterior margin thickened, on the outside very slight narrow depression parallel to the anterior margin. Posterior and vertically truncated, with rounded corners.

Anterior adductor scar elongate, nearly straight, broadening towards posterior; ranging in length from slightly longer to slightly shorter than the ligament. Posterior adductor scar long-oval, situated at a distance of about $1\frac{3}{4}$ - $1\frac{1}{2}$ its length from the pallial sinus. Ventral pallial line below the anterior adductor scar closer to the ventral than to the dorsal margin, gradually descending towards its lowermost point in the middle of the valve, then only very slightly raising towards the pallial sinus. Pallial sinus short and broad, rounded to trapezoid, its innermost point on the upper part. Distance between innermost point of pallial sinus and posterior margin relative to the total length of the valves 1: 5.8 to 1: 7.1 (mean: 6.3, n = 4).

Exterior smooth and glossy, with faint growth lines. Colour of valves creamy-white, with dense narrow pale rose to pinkish growth zones, often merging on the postero-dorsal part. Ends of the postero-dorsal vertical growth zones on the earlier part of adult valves (up to the middle) conspicuously marked with dark brownish red points and spots. Anterior part more intensively coloured, delimited by a sharp vertical line going from the umbo to the ventral margin. Periostracum thin, translucent and pale olive.

Animal not known.

Distribution: Known from the west coast of Madagascar and the coast of central East Africa (Kenya).

Material examined: the type material; Kenya: Shrimoni, 50 miles S of Mombasa, 1 broken juvenile specimen, leg. Bentley Buckle, 1974, MNHN. Madagascar: Tuléar, Lagoon of Tuléar, $23^{\circ}21'30''S/43^{\circ}37'57''E$, 16 m, muddy sand, dredged, 1 juvenile specimen, (anterior part cut off by the dredge), leg. Thomassin, 28. IX. 1963; Tuléar, NW of the street dam to the port, sand, shell concentrates between tide marks, a few fragments, leg. von Cosel, XI. 1986, both MNHN.

Habitat: The species inhabits fine sand in shallow water and is found occasionally at extreme low tide. It seems to be quite rare, judging from the scarce material at hand and from the fact that in the Tuléar Lagoon during nearly three weeks of intensive collecting mainly of bivalves in the intertidal zone and on subtidal shell agglomerates only one valve and a few fragments were found. Here it seems to be confined to depths well below the intertidal zone. In Nosy Be, specimens have been collected at extreme low tides, but only on rare occasions. I have not yet found specimens in old museum collections which otherwise are often a good source for rare species.

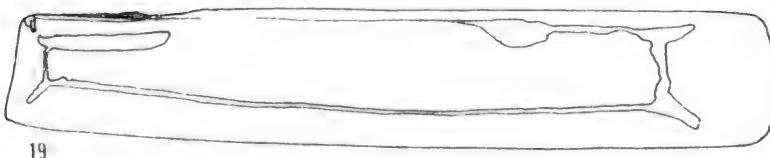
Derivatio nominis: The species is named after the Republic of Madagascar (Malagasy Republic), where the type locality, Nosy Be, is situated.

Fig. 15. *Solen roseomaculatus* Pilsbry, 1901. Tuléar, leg. Thomassin, MNHN.

Fig. 16. *Solen madagascariensis* n. sp. Holotype MNHN, Ambariahonka, Nosy Be, Madagascar, 24. X. 1961, leg. M. Chavane.

Fig. 17. *Solen madagascariensis* n. sp. Paratype MNHN, Orangea, Nosy Be, Madagascar, 17. III. 1976, leg. M. Chavane.

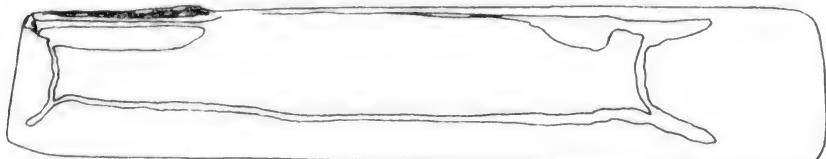
Fig. 18. *Solen madagascariensis* n. sp. Paratype Natal Museum, Tuléar, Madagascar, NE of port, 3 m, thanatocoenosis, 22. XI. 1986, leg. von Cosel.



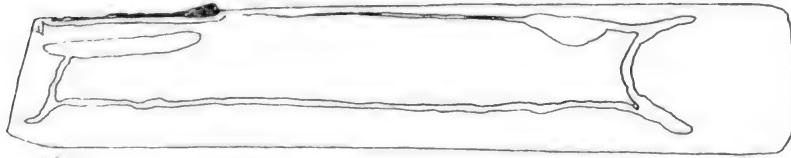
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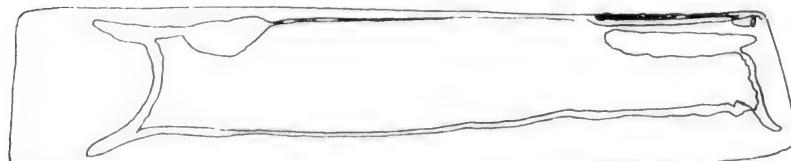
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Remarks: *S. madagascariensis* is characterized by the extraordinary distance between the posterior adductor scar and the pallial sinus. Such a large distance is common in certain species of *Ensis*, but in the Solenidae it is extremely rare. Besides *S. madagascariensis* this character is only found in an undescribed species (Fig. 20) from Papua New Guinea of which only one valve is known. In form and colour this species is also close to *S. madagascariensis*, but it is more slender (length-width ratio 6: 1), with parallel and not diverging dorsal and ventral margins and longer and more slender anterior and posterior adductor scars.

S. madagascariensis is also comparable with *S. ceylonensis* Leach, 1814 (Figs. 21–23) from the northwestern Indian Ocean (East Africa to the W-coast of India and Ceylon). This latter species is larger (up to 160 mm), shorter and broader (length-width ratio: 4·6: 1 to 5·5: 1 (mean: 5·05: 1, n = 12), and its ratio distance innermost point of pallial sinus to posterior margin/total shell length is 1: 4·5 to 1: 5·5 (mean: 4·9, n = 12)). It has more dense and more intensively coloured growth zones. The posterior adductor scar is situated much closer to the pallial sinus, in a distance of about $\frac{1}{2}$ – $\frac{1}{3}$ its length. The reddish spots delimiting the vertical growth bands on the earlier parts of *S. madagascariensis* are totally missing in *S. ceylonensis*. In the central part of East Africa the two species seem to occur sympatrically: Spry (1964, p. 39, Pl. 4, fig. 214) cites *S. ceylonensis* from Mjimwema, Tanzania, and from illustration and measurements there is no doubt that this species and not *S. madagascariensis* is concerned. From Moçambique, none of the two species is yet recorded.

Besides these two new species, three other species of *Solen* are now known from Madagascar: *S. cylindraceus* Hanley, 1843 (Fig. 13), *S. roseomaculatus* Pilsbry, 1901 (Fig. 15) and *Solen* sp. aff. *sloani* Gray in Hanley, 1842 (Fig. 14). In Tuléar, all five species occur together, but in different biotopes.

S. cylindraceus inhabits muddy sand in the upper half of the intertidal zone within an area which is exposed at low tide for 2–3 hours. As the species has a straight shell, it can bury vertically down into the sediment and avoid the drying-out of the upper layers of the sediment during exposure to the sun. This species was collected by inserting salt into the burrow holes, whereas this method did not work in the curved holes of *S. crozieri*. *S. cylindraceus* was found in a higher population density than *S. crozieri*. The species is known from the whole coast of East Africa from South Africa (Natal) to the Red Sea, and from the Gulf of Oman. In Madagascar it has been found also in Nosy Be. In the literature it is mostly cited as '*S. cornue* Lam.'

S. roseomaculatus was collected by Thomassin (1978) in various types of sediments, mostly subtidally down to 20 m, but occasionally also in tide-pools at low tide, in the whole Lagoon of Tuléar. It was found in fine sand with mud, mixed and coarse sand and also in coral sand, but not in the intertidal fine sand or muddy sand biotopes near the town of Tuléar. I found only empty shells in the subtidal shell concentrates southeast of the port. The species has also been collected in Nosy Be. This is one of the few *Solen* species which are distributed nearly throughout the whole Indo-West Pacific from East Africa, the Red Sea and the Arabian Gulf to Japan, Australia and New Caledonia.

The third species belongs to the *S. sloanii* group, but it has not yet been positively identified as that species. One adult live specimen was dredged by Thomassin in the middle of the Tuléar Lagoon from coarse sand with mud at 8 m, a few empty shells and fragments

Fig. 19. *Solen madagascariensis* n. sp. Paratype WAM, Tuléar, SW of port, sand, thanatocoenosis, low tide, 3. XI. 1986, leg. von Cosel.

Fig. 20. *Solen* sp. Papua-New Guinea, N-coast, single valve, IRSNB.

Figs. 21–22. *Solen ceylonensis* Leach, 1814. Aden, South Yemen, coll. Moazzo, 1930, MNHN.

Fig. 23. *Solen ceylonensis* Leach, 1814. Khormaksar, Aden, on beach, coll. Major Fuller, MNHN.

were collected by him mostly before and in the northern and southern entrance of the lagoon from fine to coarse sand and coral sand. The species lives subtidally, often in coral sand and is not common. '*Solen vaginoides* Lamarck' cited from Diego-Suarez by Dautzenberg (1932, p. 110) may be this species or a large specimen of *S. roseomaculatus*.

***Solen dactylus* n. sp.**

(Figs. 24–29; Pl. 23, figs. 3–4; Pl. 24, figs. 1–3; Pl. 25)

Solen vagina: Tadjalli-Pour, 1974, p. 188; Pl. 24, fig. 8; Ahmed, 1975, p. 37; Figs. 50 a,b

Solen species: Smythe, 1982, p. 112

Solen capensis: Glayzer, Glayzer & Smythe, 1984, pp. 316, 326

Solen truncatus: Kundu, 1965, p. 222; Pl. 26, figs. 88a,b

Type material: Holotype NMW, Karachi, Pakistan, leg. H. C. Winckworth, XI. 1932, Melvill-Tomlin Coll. NMW 1955. 158. 1210; paratypes: same locality, 1 specimen, NMW 1955. 158. 1211. Karachi, Pakistan, leg. H. C. Winckworth, 1 specimen, BMNH. Kuwait Bay, NW-coast, Kuwait, Arabian Gulf, 2 shells, 1 valve, MNHN, 1 shell, WAM, 1 shell, Natal Museum, 1 shell, SMF, all leg. J. C. Plaziat, III. 1985.

Type locality: Karachi, Pakistan.

Diagnosis: A moderately large, solid, white, elongate-rectangular straight *Solen* with parallel dorsal and ventral margins, sharply and mostly obliquely truncated anterior and posterior ends, the posterior adductor scar connected with the pallial sinus, with an unusually long ventral limb of the pallial sinus and with a sharp, deep and narrow external furrow parallel to the anterior margin.

Description: Shell medium-sized to large (100–136 mm), moderately thin to quite thick and strong, elongate-rectangular, straight, with length-width ratio 5·1: 1 to 6·1: 1 (mean 5·7: 1, n = 21) (see Table 3). Dorsal and ventral margin usually straight, occasionally ventral margin very faintly concave. Margins parallel or very slightly diverging, the broadest part of the valves generally situated at the posterior end. Hinge and ligamental area only faintly bent upwards. Anterior end obliquely or vertically truncated, anterior margin usually weakly convex, thickened on the inside. One valve of the pair often more or less slightly twisted along the longitudinal axis. Exterior with sharp, deep and narrow furrow just behind the margin, this furrow is vertical or weakly inclined towards anterior or posterior. Furrow ending in a depression on the antero-ventral corner. Posterior and obliquely, rarely vertically truncated, with sharp corners, posterior margin slightly concave, straight or occasionally very slightly convex.

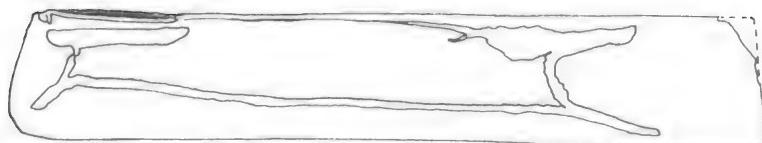
Anterior adductor scar elongate, moderately long, ranging in length from slightly longer to slightly shorter than the ligament, a bit inclined towards postero-dorsal, its posterior end weakly bent upwards. Posterior adductor scar elongate-oval, directly before and connected with the pallial sinus. Ventral pallial line below the anterior adductor scar closer to the ventral than to the dorsal margin and towards posterior either ascending for a very short

Fig. 24. *Solen dactylus* n. sp. Holotype NMW, Karachi, Pakistan, XI. 1932, leg. H. C. Winckworth, Melvill-Tomlin coll.

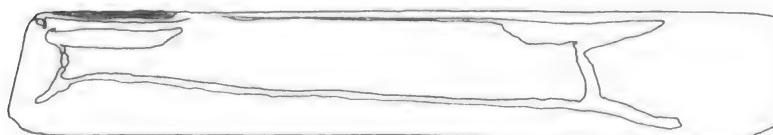
Fig. 25. *Solen dactylus* n. sp. Paratype NMW, same lot.

Fig. 26. *Solen dactylus* n. sp. Ras Tanajib, Saudi Arabia, single valve, leg. Plaziat, XI. 1985, MNHN.

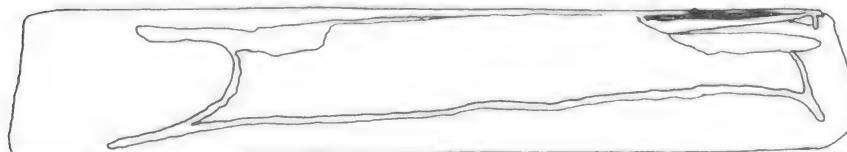
Figs. 27–29. *Solen dactylus* n. sp. Al Barah, N-coast of Kuwait Bay, Kuwait, single valves, leg. Plaziat, III. 1987, MNHN.



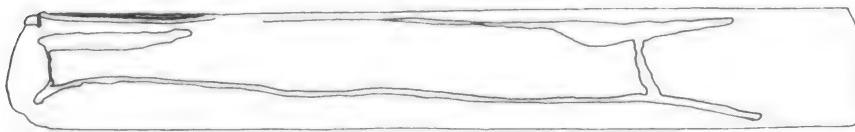
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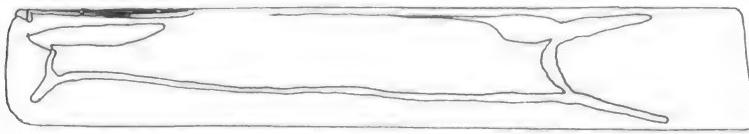
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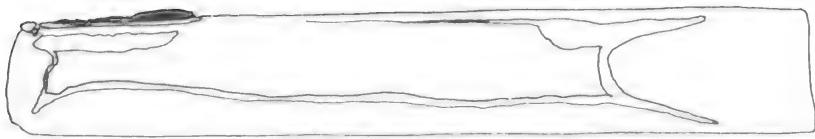


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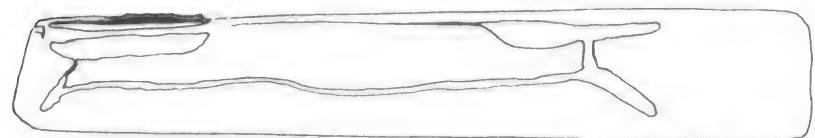


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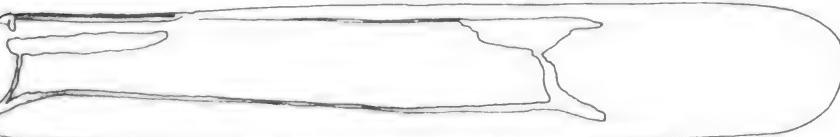




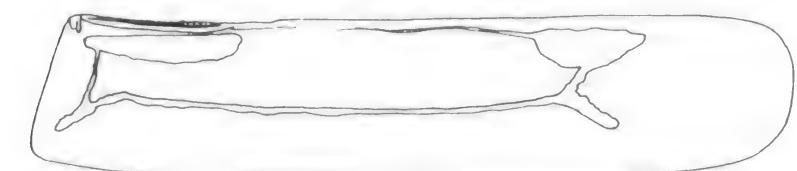
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TABLE 3 SELECTED MEASUREMENTS OF *SOLEN DACTYLUS*

<i>length</i>	<i>width</i>	<i>ratio</i>	<i>locality</i>
136·0	23·3 mm	5·8:1	Aden (erroneous)
133·8	23·1 mm	5·8:1	Ras Tanajib, Saudi Arabia
130·7	23·0 mm	5·7:1	Karachi (paratype BMNH)
127·3	21·7 mm	5·9:1	Ras Tanajib
123·0	21·6 mm	5·7:1	Ras Tanajib
122·4	22·8 mm	5·4:1	Ras Tanajib
122·0	21·0 mm	5·8:1	Ras Tanajib
115·9	19·1 mm	6·1:1	Kuwait Bay (paratype MNHN)
113·5	21·2 mm	5·4:1	Karachi (Holotype)
108·2	19·4 mm	5·6:1	Kuwait Bay
106·8	17·7 mm	6·0:1	Kuwait Bay (part. Natal Mus.)
103·7	17·8 mm	5·8:1	Kuwait Bay (paratype WAM)
102·5	17·0 mm	6·0:1	Kuwait Bay
101·4	18·0 mm	5·6:1	Abu Ali, Saudi Arabia
101·2	18·3 mm	5·5:1	Kuwait Bay (paratype MNHN)
97·1	16·7 mm	5·8:1	Kuwait Bay (paratype SMF)
95·7	17·9 mm	5·3:1	Abu Ali, Saudi Arabia
95·4	16·0 mm	6·0:1	Kuwait Bay
92·7	15·3 mm	6·1:1	Kuwait Bay
87·5	15·9 mm	5·5:1	Karachi (paratype NMW)
78·3	15·2 mm	5·2:1	Kuwait Bay
69·0	13·4 mm	5·1:1	Kuwait Bay
66·2	12·7 mm	5·2:1	Kuwait Bay

distance and then gradually descending or directly descending and reaching its lowermost point at the pallial sinus. Pallial sinus moderately deep and broad, rounded or oblique-trapezoid with an extremely long ventral limb. Innermost point at the upper part, usually directly below the dorsal limb. Distance between the innermost point of the pallial sinus and the posterior margin relative to the total length of the valves 1: 3·5 to 1: 4·3 (mean: 3·9, n = 12).

Exterior with irregular growth lines, sometimes well marked. Colour of valves uniform ivory white. Periostracum light olive green, often heavily eroded.

Animal with uniform pale beige siphons (after a colour photo by J. C. Plaziat), otherwise unknown.

Distribution: Endemic to the Arabian Gulf and eastward along the coast of Pakistan to Kathiawar State, India (Gulf of Kutch). Apparently not in the extreme southern part of the Gulf or the south coast of the Gulf of Oman.

Material examined: the type material; India: Kathiawar (no precise locality), 1 shell, coll. A. E. Salisbury, BMNH. Pakistan: Baba Island (24°50'N/66°58'E), 8 + 5 shells, coll. H. C. Winckworth, 1. XI. 1932. Karachi, 5 shells (associated specimens to the paratype BMNH), coll. H. C. Winckworth; Karachi, 4 juvenile shells, coll. H. C. Winckworth, 20. XI. 1932, all BMNH. Iran: Bendar Abbas, on beach, 1 v., 1 fragment, leg. Tadjalli-Pour, 1973, MNHN. Kuwait: Al Bahrah and SW of Al Bahrah, N-coast of Kuwait Bay, on tidal flats, mud, several shells and valves, leg. Plaziat, III. 1987, MNHN; Kuwait (no precise locality), 3 valves, coll. Biggs, BMNH. Saudi Arabia: Ras Tanajib, N of Manifa Lagoon, on beach,

Fig. 30. *Solen marginatus* Pulteney, 1799. La Franqui, Roussillon, Mediterranean France, on beach, leg. von Cosel, MNHN.

Fig. 31. *Solen capensis* P. Fischer, 1881. Plettemberg Bay, South Africa, coll. Lavranos, 1976, MNHN.

Fig. 32. *Solen digitalis* Jousseaume, 1891. Syntype MNHN, Aden, coll. Jousseaume, 1921.

several valves, leg. Plaziat, XI. 1985, MNHN; South of Abu Ali Island (N of Tubait), on beach, leg. Plaziat, XI. 1985, MNHN.

Habitat: *Solen dactylus* lives in mud and fine sand with mud and detritus on tidal flats in the lower intertidal zone, where it can be found in high population densities. On a photograph of a sediment surface of about 20×30 cm taken in the northern part of the Bay of Kuwait by Plaziat, 17 holes of *Solen dactylus* can be recognized, which means a population density of over 250 specimens per square metre in that area (Pl. 25, fig. 1).

Remarks: There is no closely related species to *S. dactylus*. It can only be compared with the well known *S. marginatus* Pulteney, 1799 (Fig. 30) from the NE-Atlantic which has a similar general shape. *S. marginatus* differs from *S. dactylus* by the following characters: vertical furrow behind the anterior margin broader and not so sharp, pallial sinus shorter and narrower, posterior end with rounded and not with sharp corners, ventral pallial line more

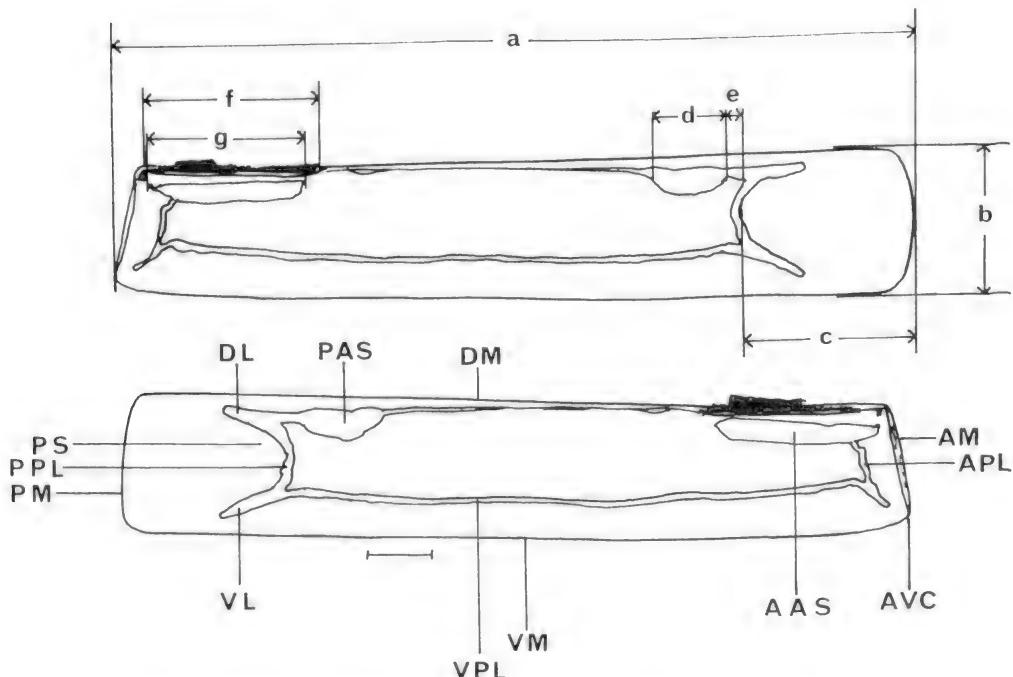


Fig. 33. Diagram of a *Solen* shell (*S. ceylonensis*, Khormaksar, Aden, coll. Major Fuller, 2. specimen, MNHN) with explanations of shell characters and parameters used in the descriptions. Scale in all Figures: 1 cm.

Abbreviations: AAS: anterior adductor scar. AM: anterior margin of valve. APL: anterior pallial line. AVC: antero-ventral corner. DL: dorsal limb of pallial sinus. DM: dorsal margin of valve. PAS: posterior adductor scar. PM: posterior margin of valve. PPL: posterior pallial line. PS: pallial sinus. VL: ventral limb of pallial sinus. VM: ventral margin of valve. VPL: ventral pallial line.

parameters: a = total shell length; b = greatest width of shell; a:b = length/width ratio; c = distance of the innermost point of the pallial sinus to the posterior margin; c:a = ratio distance innermost point of pallial sinus – posterior margin/total shell length; d = length of posterior adductor scar; e = distance between posterior adductor scar and pallial sinus; f = ligament length; g = length of anterior adductor scar.

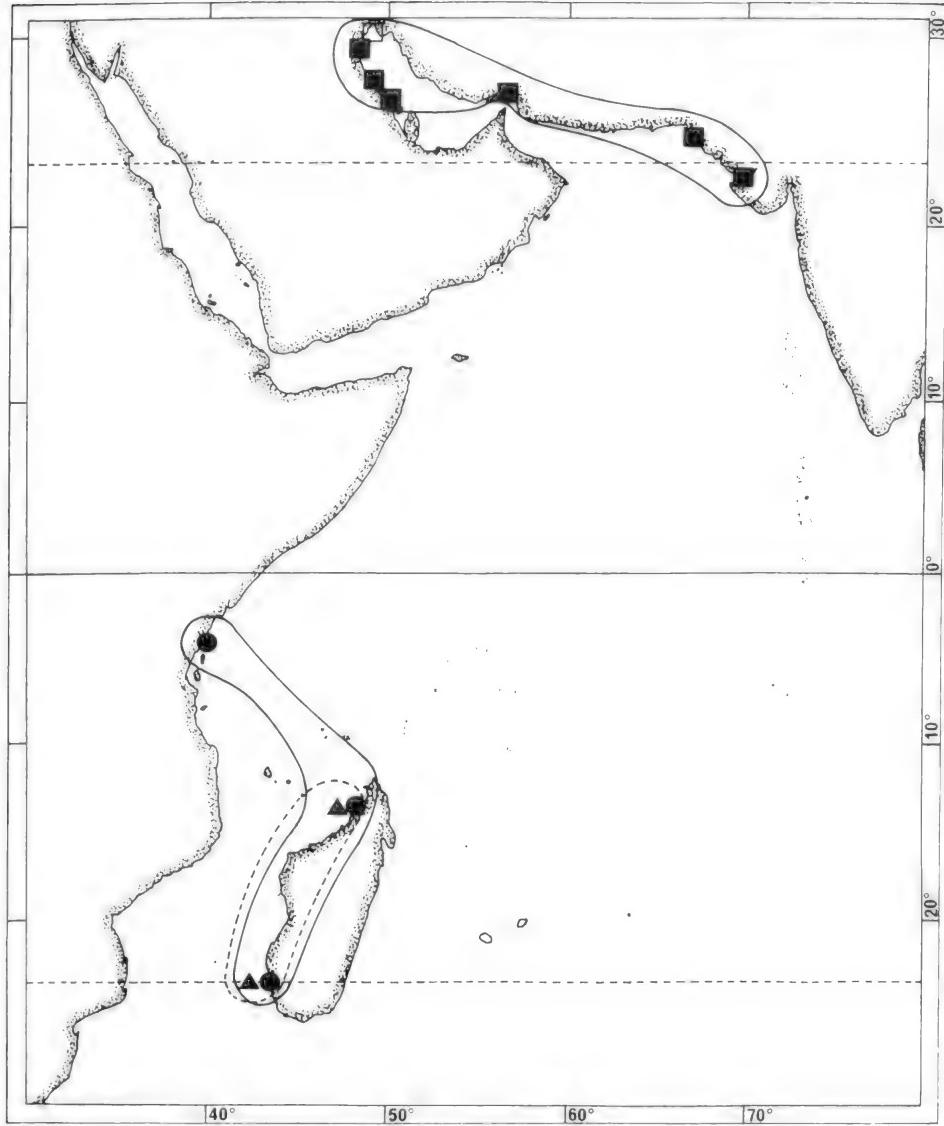


Fig. 34. Distribution of the new species of *Solen* in the Western Indian Ocean. Triangles: *Solen crozieri*. Circles: *Solen madagascariensis*. Squares: *Solen dactylus*.

convex and raising again towards posterior, shell often coloured. *S. capensis* P. Fischer, 1881 (Fig. 31) from South Africa has also a sharp anterior furrow, but its posterior end is distinctly rounded, and the valves are more slender and usually coloured. — The new species has been known, although misidentified, for a considerable time.. Around the Arabian Gulf the name '*S. vagina* Linné' has been used for it (Tadjalli-Pour 1974, Ahmed 1975); Glazyer et al. (1984) referred to this species as '*S. capensis*' and Kundu (1965) as '*S. truncatus*'.

The name '*S. dactylus* Jouss.' was first published by Shopland (1902, p. 177) in his checklist of marine shells from Aden without any comments or reference. Jousseaume himself has never described a species under this name, and there is no species with this name in the Jousseaume collection now in the MNHN. The only *Solen* species described by him is *S. digitalis* Jousseaume, 1891 (Fig. 32) from Aden (type locality) and the south coast of the Arabian peninsula eastward to Muscat. This species (of which the type lot and three other lots from Aden and one specimen from Muscat are present in the MNHN) is not mentioned in the list of Shopland, so it is probable that Shopland thought of the Jousseaume species in writing the name *dactylus*.

The name *dactylus* cannot be considered as a demonstrably intentional emendation of *digitalis*, although the common classical origin (Greek vs. Latin) of the two names is obvious. Therefore, according to ICZN 33, I regard *dactylus* as published by Shopland as an incorrect subsequent spelling. This leaves the name *dactylus* available for the new species here described, since *dactylus* of Shopland does not enter into homonymy. — *S. digitalis* Jousseaume is completely different from *S. dactylus* n. sp. It is close to *S. brevis* Gray in Hanley, 1842, has no anterior furrow, is shorter, and its posterior end is rounded.

In the Melvill-Tomlin collection in the NMW Cardiff, a lot of two specimens of the new species from Karachi, collected by H. C. Winckworth and labelled by R. Winckworth as '*Solen dactylus* Jouss.', was found. R. Winckworth is apparently the first who has assigned the name *dactylus* to the Arabian Gulf species, most probably he took the name from Shopland (1902). In the BMNH there is a lot of 6 shells and one valve with the same name, also from Karachi, from the Bloomer collection. It is probable that this material was also collected by H. C. Winckworth; one specimen of this lot is selected here paratype. Two other lots in BMNH (1 specimen each, one no. 1936.1.8.123) of the same species are labelled 'Aden'; they may have been assigned to this locality erroneously because Aden was at that time a place from which often shells etc. collected at other localities may have been shipped to England with the label 'Aden'.

Solen dactylus has never been positively recorded from Aden, it is not present in the extensive and well localized mollusc material from this region in the MNHN, but three other species of *Solen* (*ceylonensis* Leach, *digitalis* Jousseaume and *cylindraceus* Hanley) are in that material. The species is not mentioned by Biggs (1973), Smythe (1979) and Bosch & Bosch (1982) in their detailed works on the southern part of the Arabian Gulf and Oman. It is also not present in the rather complete collection of marine molluscs from Sharjah and Oman (which contains specimens of *S. digitalis* Jousseaume, *S. brevis* Hanley and *S. sloanii* Gray in Hanley) gathered by Pauline Carson and now in the Royal Scottish Museum at Edinburgh. Furthermore it is not among the extensive *Solen* material collected recently by W. Wrani (Wilhelm Pieck University Rostock, GDR) and students around Aden and the Gulf of Aden (*S. ceylonensis* Leach, *S. digitalis* Jousseaume, *S. roseomaculatus* Pilsbry and *S. cylindraceus* Hanley). So *S. dactylus* seems to be confined to the Indian Ocean coast of Pakistan and Iran and the northern (inner) part of the Arabian Gulf down to a line between the Strait of Hormuz and the Peninsula of Qatar. One explanation for this distribution pattern can be the current system of that area: the current comes from the east and flows into the Gulf along the Iranian coast and then turns SE-wards along the coast of Saudi-Arabia forming several eddies (see Smythe 1982). Due to the intensive evaporation in the shallow water body of the Gulf there is nearly no backflow to the Indian Ocean and so only very little transport of

planktonic larvae. The area of upwelling water at the south coast of Oman (for details see Taylor & Smythe 1985) could be another hydrological barrier for the warm water and soft bottom species of the Arabian Gulf. Towards the east, there is the biological barrier of the mouth of the Indus river with reduced salinity, but according to Kundu (1965) and the material from Kathiawar Peninsula, India, the species goes further eastward to the Gulf of Kutch or perhaps the Gulf of Cambay. Kundu (1965) cites it as *Solen truncatus* Wood from Belarpur Bay (Gulf of Kutch), where it is very abundant and where it was 'mostly caught alive' (p. 234). The species is locally found in very dense populations, but only in its special environments. It is used for bait and occasionally consumed.

ACKNOWLEDGEMENTS

It is a pleasure for me to thank several persons and institutions for their help in field and laboratory. For donation of the holotype of *Solen madagascariensis* I thank Dr. Ralison, at that time director of the Centre National de Recherches Océanographiques (CNRO) in Nosy Be, Madagascar, and the curator of the collections of this institution, H. Randrianasolo-Ionjanahary, who also accompanied me on field trips at Tuléar and Nosy Be. Mrs. Monique Chavane, Nice, donated one paratype of *S. madagascariensis*. I am particularly grateful to J. C. Plaziat, Laboratoire de Petrologie sédimentaire et Paléontologie, Université Paris-Sud, who collected most Arabian Gulf specimens of *Solen dactylus* referred to herein, during his recent trips to Saudi Arabia and Kuwait, and who provided me with ecological data and biotope photos. For loaning of the holotype and one paratype of this species I thank P. G. Oliver from NMW Cardiff. W. Wranik, Biology Section, Wilhelm Pieck University Rostock, GDR, is thanked for sending me Solenacea material from the Aden region for study. For loaning the specimen of *Solen* sp. from Papua-New Guinea I thank J. Van Goethem, IRSNB, and for allowing me to study the BMNH material I am grateful to S. Morris. She and Ph. Bouchet are thanked for reading the manuscript.

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VON COSEL: *SOLEN*

PLATE 21

- Fig. 1. *Solen crosnieri* n. sp. holotype MNHN. Tuléar, Madagascar. Exterior and interior of both valves.
Fig. 2. *Solen crosnieri* n. sp. paratype MNHN. Tuléar, Madagascar. Interior of right valve.
Fig. 3. *Solen crosnieri* n. sp. paratype MNHN. Tuléar, Madagascar. Exterior of right valve.
Fig. 4. *Solen crosnieri* n. sp. paratype MNHN. Tuléar, Madagascar. Exterior of left valve.
Fig. 5. *Solen crosnieri* n. sp. paratype SMF. Tuléar, Madagascar. Exterior of left valve.
all ca. $\times 2$ (scale: 1 cm)

PLATE 22

- Fig. 1. *Solen madagascariensis* n. sp. holotype MNHN. Ambariahonka, Nosy Be, Madagascar. Exterior and interior of both valves.
Fig. 2. *Solen madagascariensis* n. sp. paratype MNHN. Orangea, Nosy Be, Madagascar. Exterior and interior of both valves.
all ca. $\times 1$ (scale: 1 cm)

PLATE 23

- Fig. 1. *Solen madagascariensis* n. sp. paratype SMF. Ambatoloaka, Nosy Be, Madagascar, fine sand, 2 m, 8. XII. 1986,
leg. von Cosel. Exterior and interior of left valve.
Fig. 2. *Solen madagascariensis* n. sp. paratype WAM. Tuléar, Madagascar. Interior of left valve, ca. $\times 2$ (scale: 0.5 cm)
Fig. 3. *Solen dactylus* n. sp. holotype NMW. Karachi, Pakistan. Interior and exterior of both valves.
Fig. 4. *Solen dactylus* n. sp. paratype BMNH. Karachi, Pakistan. Exterior of left valve.
all ca. $\times 1$ (scale: 1 cm) (if not otherwise stated)

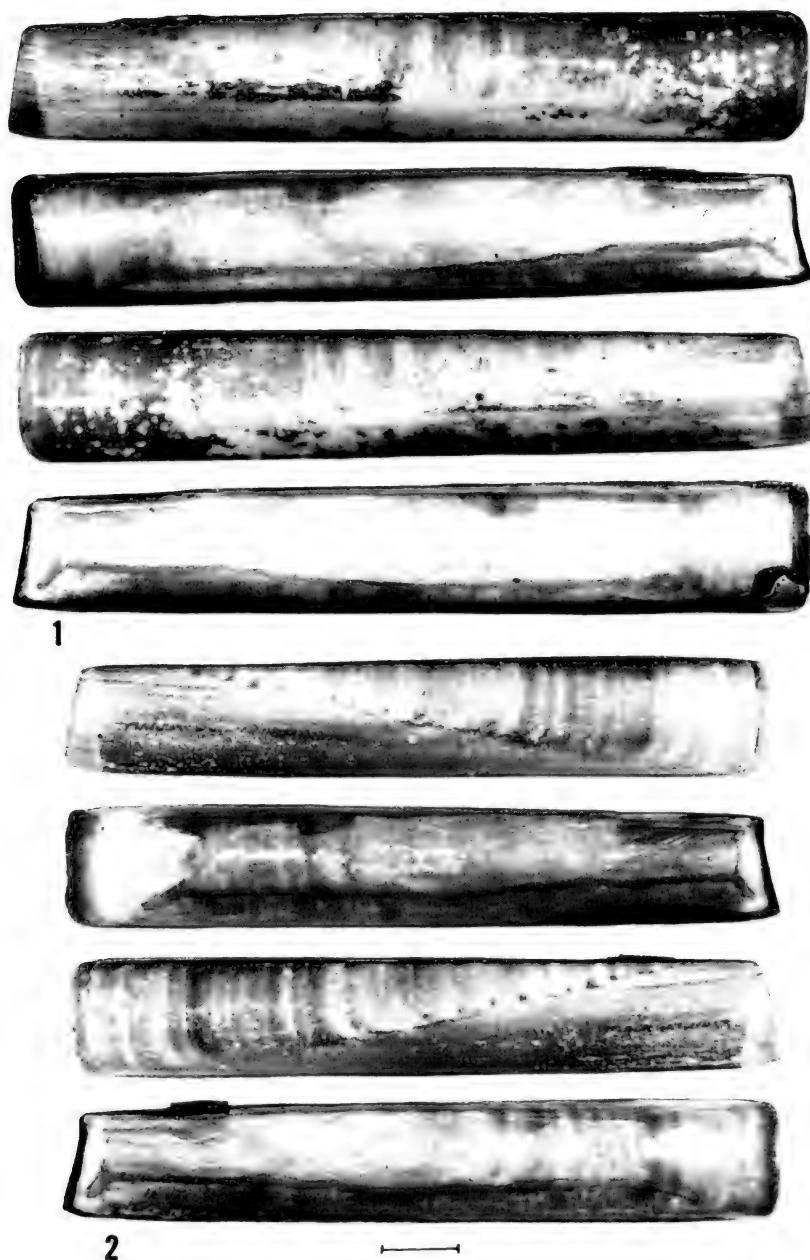
PLATE 24

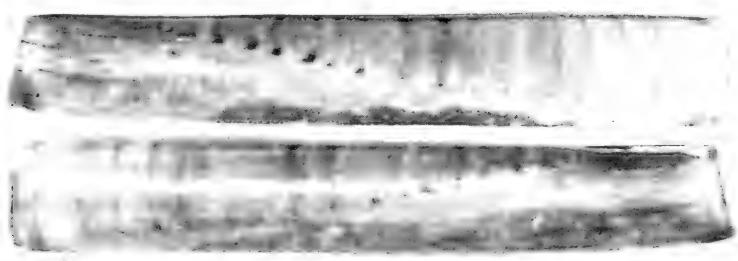
- Fig. 1. *Solen dactylus* n. sp. paratype NMW. Karachi, Pakistan. Interior and exterior of both valves.
Fig. 2. *Solen dactylus* n. sp. paratype MNHN. Kuwait Bay, Kuwait. Exterior of both valves.
Fig. 3. *Solen dactylus* n. sp. paratype MNHN. Kuwait Bay, Kuwait. Exterior of both valves.
all ca. $\times 1$ (scale: 1 cm)

PLATE 25

- Locality of *Solen dactylus* at the N-coast of Kuwait Bay.
Fig. 1. typical keyhole-shaped holes of *Solen dactylus* and rounded holes of an echiurid near low water mark.
Fig. 2. specimen of *Solen dactylus* and the keyhole-shaped holes, same place.
Fig. 3. agglomerations of empty shells of *Solen dactylus*.
photographs by J.-C. Plaziat, March, 1987.



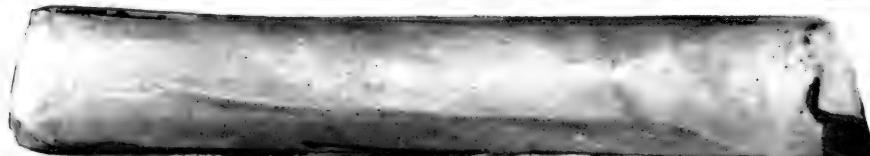
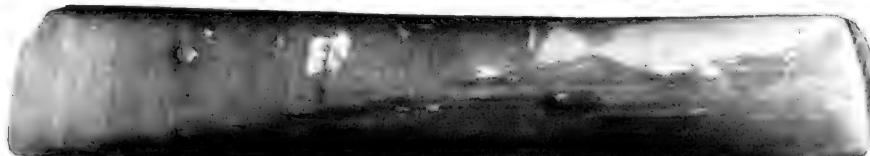
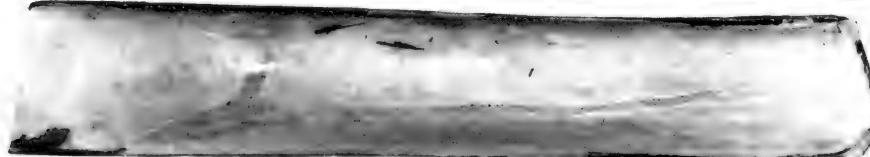




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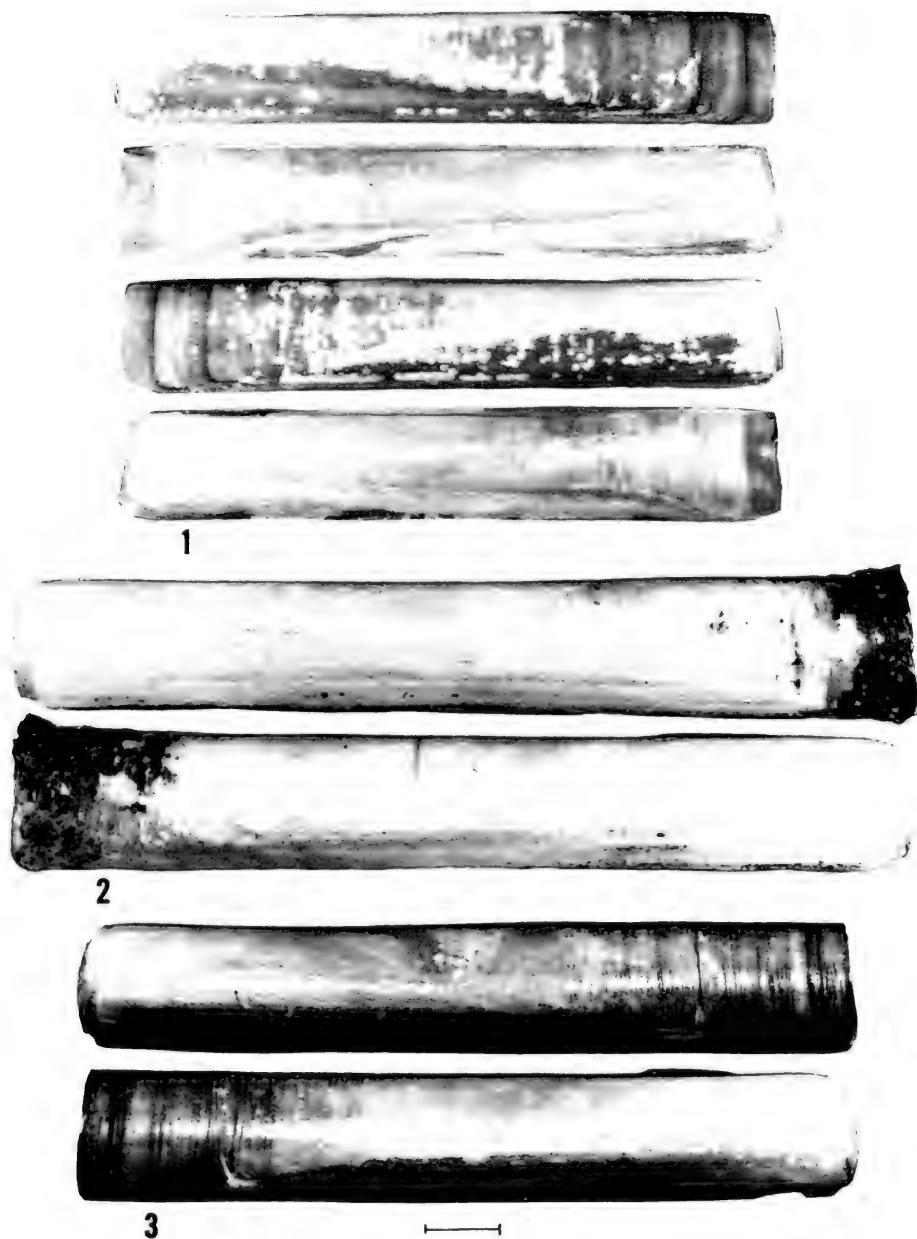


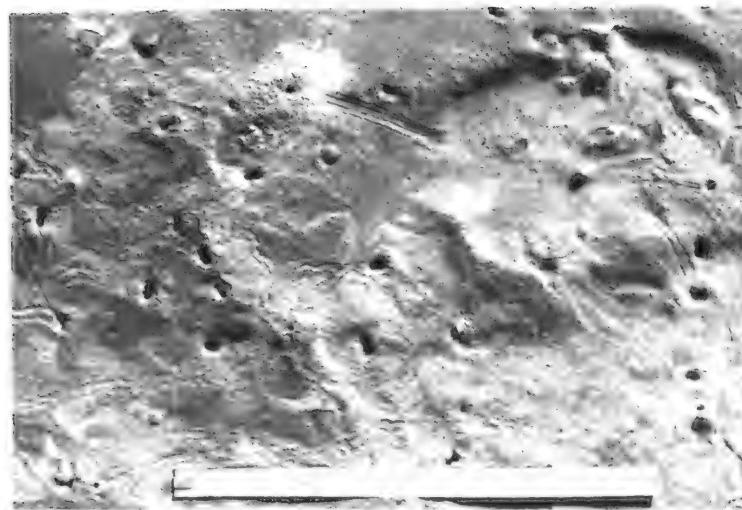
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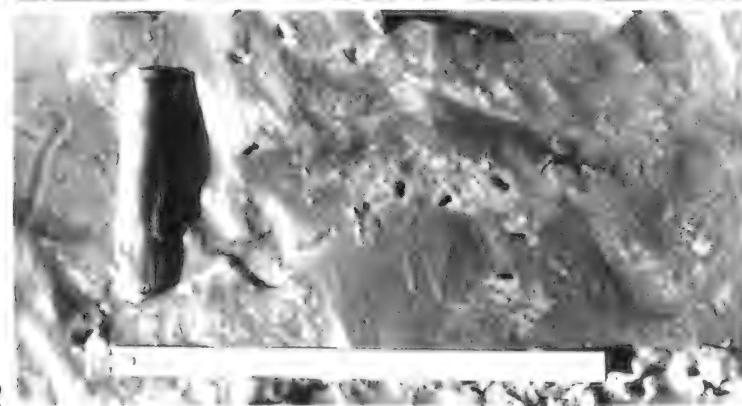
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PLATE 23





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PLATE 25

NOTE SUR LE GENRE *DACRYDIUM* TORELL, 1859 DANS L'OCEAN INDIEN (MOLLUSQUES BIVALVES: MYTILIDAE), AVEC DESCRIPTION DE DEUX ESPECES NOUVELLES.

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(Accepted for publication, 20th May 1989)

Abstract: Note on genus *Dacrydium* Torrell, 1859 in the Indian Ocean (Mollusca Bivalvia Mytilidae), with description of two new species. The material upon which this paper is based was collected in the abyssal zone of the Indian Ocean by the 'Benthedi' expedition in the North Mozambique Channel in April 1977, and off Ceylon during the oceanographic cruise 'MD 28 – Safari II' in July 1981. It deals with three *Dacrydium* species, of which two species, *D. gloriense* and *D. speculum* are described as new. This is the first record for genus *Dacrydium* in the Indian Ocean. Comparison of the new material with other species of the genus highlights the individuality of the Indian Ocean forms and reinforces the hypothesis that distribution of most dacydiines may be restricted to a particular ocean basin at abyssal depths. The type material of the new species described in the paper is kept in the Muséum national d'Histoire naturelle, Paris.

Résumé: Le matériel étudié dans cet article a été recueilli dans la zone abyssale de l'océan Indien par l'expédition 'Benthedi' dans le nord du canal de Mozambique en Avril 1977, et au large de Ceylan lors de la campagne océanographique 'MD 28 – Safari II' en Juillet 1981. Il concerne trois espèces de *Dacrydium*, dont deux espèces *D. gloriense* et *D. speculum* sont nouvelles pour la science. Le genre *Dacrydium* est ici cité pour la première fois de l'océan Indien. La comparaison du nouveau matériel avec les autres espèces du genre fait ressortir l'originalité des formes de l'océan Indien, et conforte l'hypothèse d'une distribution restreinte à des bassins océaniques particuliers chez la plupart des Dacydiinae aux profondeurs abyssales.

INTRODUCTION

Les espèces décrites ici proviennent de récoltes réalisées dans la zone abyssale de l'océan Indien par les expéditions océanographiques 'MD 28 – Safari II' et 'Benthedi'. La première de ces expéditions a été réalisée en Juillet-Septembre 1981 par le M. S. 'Marion-Dufresne' sous la direction de Mr C. Monniot; elle a fourni une espèce de *Dacrydium* dans un carottage profond au sud-ouest de Ceylan. Les autres espèces ont été récoltées en Mars-Avril 1977 lors de la campagne 'Benthedi', effectuée dans le nord du canal de Mozambique par le navire océanographique 'Suroît', avec Mr B. Thomassin comme chef de mission et Mr P. Bouchet comme malacologue à bord. Les Bivalves abyssaux recueillis pendant cette dernière campagne comprennent une trentaine d'espèces parmi lesquelles le groupe des Septibranches a déjà fait l'objet d'un précédent rapport dans cette revue (Poutiers 1984).

L'ensemble du matériel étudié ici, y compris les holotypes des espèces nouvelles, a été déposé au laboratoire de Malacologie du Muséum national d'Histoire naturelle (M.N.H.N.) de Paris.

Pour chaque espèce on trouvera, outre une description et une illustration des spécimens récoltés, des indications sur les paramètres géographiques, bathymétriques et édaphiques

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ainsi que des remarques sur divers problèmes apparus lors de l'étude du matériel. On pourra en plus trouver dans le compte-rendu général des campagnes Safari les caractéristiques détaillées de chaque station de récolte (Monniot 1984). Seuls les caractères conchyliologiques des espèces ont été pris en compte dans cet article, compte-tenu de la rareté et de la fragilité des spécimens, ainsi que de leur mode de conservation le plus souvent à sec. Le lecteur intéressé par l'anatomie des Dacrydiinae pourra se référer aux excellentes études de Mattson et Waren (1977) et Ockelmann (1983).

Pour les figures, les longueurs en millimètres correspondent à la plus grande dimension du spécimen représenté. Certains schémas de la figure 3 ont été repris, légèrement modifiés, d'illustrations publiées par les auteurs ou les réviseurs des diverses espèces. Les autres figures de cet article, originales, sont de l'auteur.

ETUDE SYSTEMATIQUE

Dacrydium speculum n. sp. (Figs. 1a-c, 3a)

Matériel

Safari II St. 2 SIPAN 19, 24.07.81, sud-ouest de Ceylan, 5°37'N, 78°24'E, 3660 m, fond de vase fine très foncée, homogène et molle: 2 exemplaires vivants (holotype et paratype).

Holotype M.N.H.N.

Description

Largeur 1·1 mm, hauteur 0·8 mm, renflement 0·5 mm (holotype).

Coquille modérément renflée, atteignant 1·2 mm de long, équivalve, inéquivalatérale, de contour elliptique un peu plus large que haut et rostré en avant. Test mince et blanchâtre, couvert extérieurement d'un pérostracum adhérent, jaune pâle translucide et très brillant. Crochets petits et arrondis, situés antérieurement mais relativement éloignés de l'extrémité antérieure (à un niveau correspondant au quart supérieur de la hauteur des valves). Bord antérieur du test formant une expansion cunéiforme émuossée dépassant nettement le sommet de la coquille. Bord dorsal rectiligne, se raccordant subanguleusement avec la région postérieure du test qui est largement et régulièrement arrondie. Bord ventral allongé et nettement convexe. Surface externe ornée de fines marques concentriques d'accroissement, avec une coquille embryonnaire bien visible au sommet.

Ligament interne brun-corné, étiré transversalement et débordant largement vers l'intérieur du bord cardinal, s'insérant à chaque valve dans une fossette située à l'aplomb du crochet.

Charnière comportant deux séries de fines crénélures transverses séparées par la fossette résilière. Séries antérieure et postérieure subégales, comprenant chacune une douzaine de crénélures, la postérieure prolongée vers l'arrière par un épaissement marginal interne du test assez allongé. Surface interne de la coquille lisse et mate, à empreintes musculaires indistinctes.

Adducteur antérieur subtrigone, situé près de l'extrémité antérieure. Adducteur postérieur arrondi, situé environ au niveau du tiers postérieur des valves.

Remarques

Par rapport à *D. gloriosense*, cette espèce est caractérisée par un contour elliptique et non subovale, une disposition moins redressée pour le bord dorsal et moins antérieure pour les crochets, ainsi que par un bord ventral nettement convexe et non subrectiligne. Elle se reconnaît du spécimen non nommé de la St. 87CH de Benthedi mentionné ci-après, par son aire antéroventrale bien plus développée et l'absence de sinuosité du bord ventral.

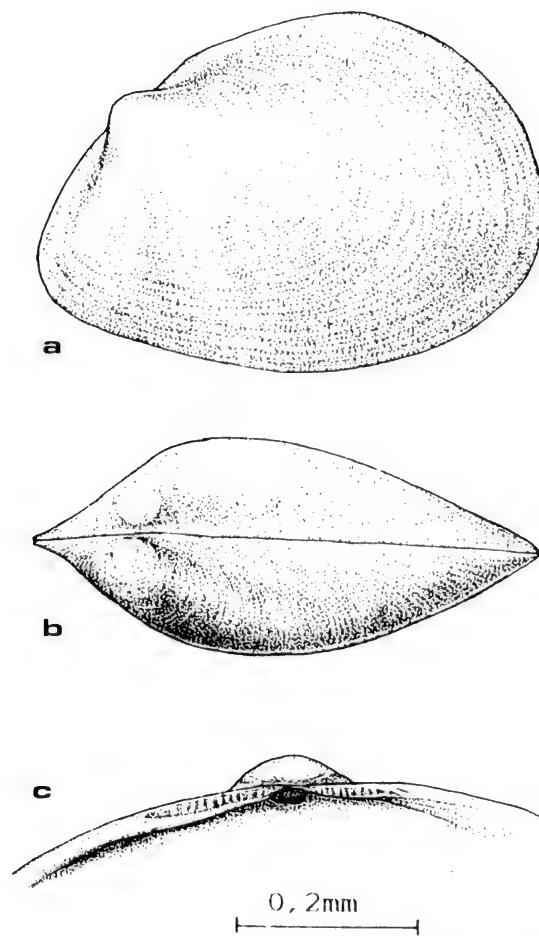


Fig. 1. *Dacrydium speculum* n.sp.: a, vue externe du test, côté gauche; b, vue dorsale; c, charnière de la valve gauche, vue interne (a & b, holotype, 1·1 mm; c, paratype).

Parmi les autres espèces du genre *Dacrydium*, *D. speculum* rappelle un peu par son contour globuleux *D. pacificum* Dall, 1916, espèce abyssale du Pacifique nord qui a été redéfinie et figurée par Knudsen (1970b, pp. 89–91, Fig. 52 C–E); elle s'en distingue cependant nettement par ses crochets non terminaux et par les séries de crénélures subégales et non très dissymétriques à la charnière. Ce dernier caractère la différencie aussi de *D. vitreum* (Möller, 1842) dont elle diverge également par une forme plus convexe ventralement et moins rostrée antérieurement, l'absence de callosité au niveau de l'adducteur antérieur et la position moins postérieure de l'autre adducteur.

Distribution

Cette espèce n'est connue que de la localité type située au sud-ouest de Ceylan par 3660 m de fond.

***Dacrydium gloriense* n.sp. (Figs. 2a–c, 3g)**

Matériel

Benthedi St. 87 CH, 3.04.77, sud-est des îles Glorieuses, 11°44'S, 47°35'E, 3716 m: 1 exemplaire vivant à coquille endommagée (paratype).

Benthedi St. 90 CH, 4.04.77, sud-est des îles Glorieuses, 11°44'S, 47°30'E, 3700 m: 1 exemplaire vivant (holotype).

Holotype: M.N.H.N.

Description

Largeur 2·7 mm, hauteur 1·9 mm, renflement 1·1 mm (holotype).

Coquille modérément renflée, équivalve, inéquilatérale, de contour allongé subovale, à test mince et luisant, plus ou moins translucide. Crochets petits et assez peu saillants, situés antérieurement, éloignés de l'extrémité antérieure d'une distance supérieure à la mi-hauteur des valves. Bord antérieur de chaque valve formant une expansion arrondie dépassant le sommet de la coquille. Bord dorsal subrectiligne, se raccordant sans discontinuité avec les bords antérieur et postérieur. Région postérieure du test largement arrondie. Bord ventral allongé et rectiligne. Surface externe des valves à sculpture composée uniquement de fines et nombreuses marques concentriques d'accroissement.

Ligament interne beige-corné, bien développé, logé à chaque valve dans une fossette pointant sous le crochet et interrompant la charnière ventralement.

Charnière munie de part et d'autre de la fossette résilifère d'une série de fines crénélures transverses; série antérieure bien développée comprenant une quinzaine de crénélures, mesurant à peu près les deux cinquièmes de la longueur de la série postérieure qui comporte environ vingt-cinq crénélures; séries antérieure et postérieure effilées distalement par rapport à la fossette résilifère.

Adducteur antérieur des valves réniforme, situé près de l'extrémité antérieure du bord ventral. Adducteur postérieur ovale, un peu plus gros que l'adducteur antérieur, situé aux deux-tiers de la distance séparant les crochets de l'extrémité postérieure du test.

Remarques

Pour les rapports et différences avec les deux autres espèces récoltées lors des expéditions Safari II et Benthedi, se reporter aux commentaires sur ces espèces.

Par son contour et la position de ses adducteurs, cette espèce se rapproche de *D. panamensis* Knudsen, 1970 de l'abyssal du Pacifique oriental (golfe de Panama); elle en diffère cependant par ses crochets situés plus en arrière et au-dessus de la mi-hauteur des valves, son bord dorsal moins redressé par rapport au bord ventral, ainsi que par la longueur plus importante de la série antérieure de crénélures cardinales (elle ne fait qu'environ 15% de la longueur de la série postérieure chez *D. panamensis*).

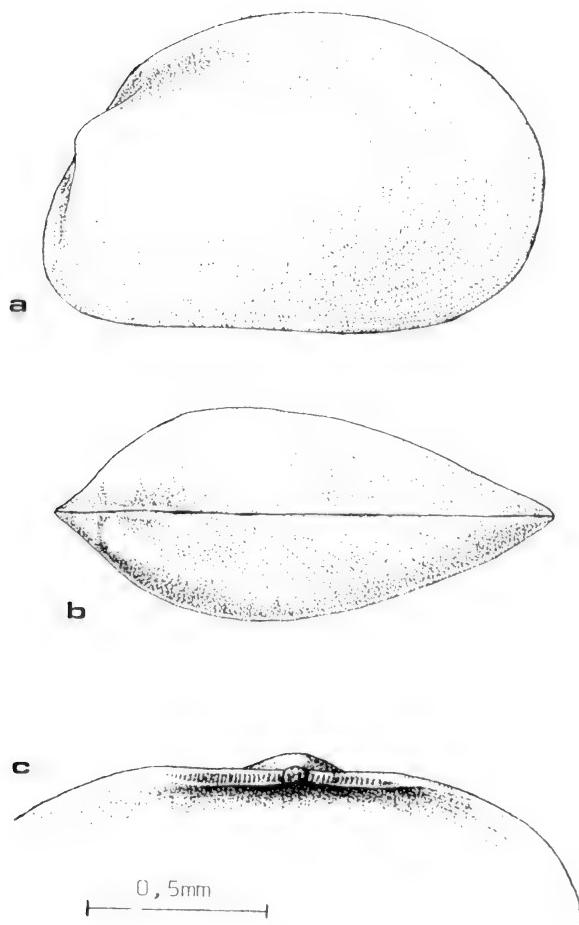


Fig. 2. *Dacrydium gloriosense* n.sp.: a, vue externe du test, côté gauche; b, vue dorsale; c, charnière de la valve gauche, vue interne (a & b, holotype, 2,7 mm; c, paratype).

D. gloriosense se distingue de *D. nipponicum* Okutani, 1975 du bathyal du Pacifique nord-ouest par son bord ventral rectiligne et non largement convexe, sa forme proportionnellement plus haute, son aire antéro-ventrale plus développée et son bord dorsal postérieur plus court. La coquille de *D. angulare* Ockelmann, 1983 du bathyal de l'Atlantique sud, a des crochets plus rapprochés de l'extrémité antéro-ventrale du test, un bord dorsal postérieur plus développé et une dissymétrie plus importante entre les deux séries de crénélures cardinales (la longueur de la série antérieure atteint la moitié de la dimension de la postérieure). La présente espèce nouvelle montre une certaine analogie de contour avec le spécimen figuré par Pelseneer (1903, Pl. 8 fig. 100) dans sa description originale de *D. albidum* de l'Antarctique; elle se reconnaît pourtant à son aire antéroventrale encore plus haute, son bord ventral dépourvu de sinuosité, son adducteur postérieur situé bien plus en arrière et sa charnière différemment conformée (les deux séries de crénélures cardinales de *D. albidum* sont très dissymétriques et supportées par un épaissement marqué du bord dorsal).

Distribution

D. gloriosense n'est connue que du sud-est des îles Glorieuses, où elle a été récoltée vivante vers 3700 m de profondeur.

Dacrydium sp. (Fig. 3d)

Materiel

Benthedi St. 87 CH, 3.04.77, sud-est des îles Glorieuses, 11°44'S, 47°35'E, 3716 m: 1 exemplaire vivant, à test endommagé.

Remarques

Eu égard à l'assez mauvais état de conservation de ce spécimen, il a paru préférable de ne pas attribuer de nom spécifique à ce *Dacrydium*.

Pour la comparaison avec *D. speculum*, se reporter au commentaire sur cette espèce. Par rapport à *D. gloriosense*, ce spécimen se reconnaît aisément à sa forme rostrée en avant, ses crochets situés plus en arrière et au-dessous de la mi-hauteur des valves, son bord ventral présentant une légère sinuosité. Cette concavité du bord ventral la rapproche un peu de plusieurs autres espèces, parmi lesquelles *D. occidentale* Smith, 1885 du bathyal des Indes Occidentales, dont le contour est plutôt quadrangulaire; *D. rostriferum* Bernard, 1978 de l'abyssal du Pacifique nord-est, dont le rapport hauteur/largeur est plus faible et la rostration antérieure bien plus prononcée; la forme attribuée par Thiele (1912, Pl. 17 figs. 10-10a) à *D. albidum*, qui possède cependant un bord dorsal plus oblique et non sub-anguleux en arrière, ainsi qu'un contour plus étiré en largeur. A propos de cette dernière espèce, il faut signaler d'importantes incertitudes concernant sa variabilité et sa répartition dans le domaine antarctique. En effet, le spécimen figuré par Thiele en 1912 présente des caractères sensiblement "intermédiaires" entre ceux du spécimen original de Pelseneer et ceux de *D. modioliforme* Thiele (op. cit., Pl. 17 figs. 9-9a). Cette opinion, qui a été soutenue par Nicol (1966) à partir de l'analyse du matériel des expéditions 'Deepfreeze' dans l'Antarctique, ne paraît guère avoir été suivie depuis. De plus, il semble que plusieurs formes abyssales distinctes aient été confondues avec le complexe spécifique bathyal *albidum/modioliforme* (cf. Thiele & Jaeckel 1931 pour *D. modioliforme*; Clarke 1961 et F. R. Bernard 1983 pour *D. albidum*).

REMARQUES GENERALES

Le matériel abyssal étudié dans cet article comble une lacune importante dans la distribution géographique du genre *Dacrydium* dont aucune espèce n'avait encore été décrite

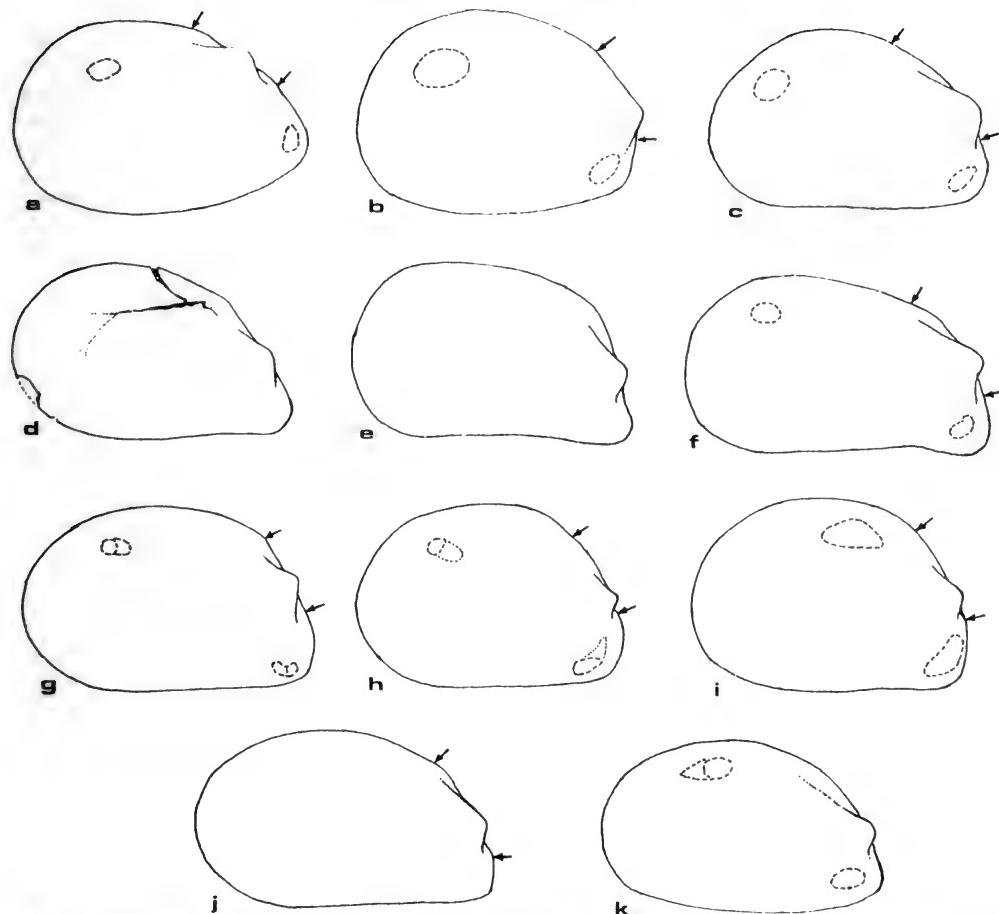


Fig. 3. Vues schématiques externes de différentes espèces de *Dacrydium*, montrant la disposition des muscles adducteurs des valves (pointillés) et l'extension des crénellures marginales (flèches): a, *D. speculum* (paratype, 1·2 mm); b, *D. pacificum*; c, *D. vitreum*; d, *D. sp.* (Benthedi St. 87 CH, 3·0 mm); e, *D. occidentale*; f, *D. rostriferum*; g, *D. gloriosense* (holotype, 2·7 mm); h, *D. panamensis*; i, *D. albidum*; j, *D. angulare*; k, *D. nipponicum*. (Figs b, c, h, d'après Knudsen 1970b; e, d'après E. A. Smith 1885; f, d'après F. R. Bernard 1978; i, d'après Pelseneer 1903; j, d'après Ockelmann 1983; k, d'après Okutani 1968, 1975).

de l'océan Indien. Ce genre n'a en effet été cité ni de l'expédition de la 'Siboga' (cf. Prashad 1932), ni de celle de 'l'Investigator' (cf. Smith 1894, 1895a, b, 1896, 1899, 1904, 1906; Wood-Mason & Alcock 1891a, b; Sowerby 1888, 1893); il se pourrait toutefois que cela soit dû à petite taille des espèces, le matériel examiné alors correspondant plutôt à de la macrofaune. Le genre n'a pas non plus été identifié dans les récoltes de l'expédition 'John Murray' (Knudsen 1967, 1970a), ni dans celles de la 'Tiefsee Expedition' (Thiele & Jaeckel 1931) qui comportent pourtant un certain nombre de micro-mollusques; ceci pourrait être un reflet de la rareté des Dacrydiinae dans l'océan Indien. Il faut de plus exclure le *D. meridionale* Smith, 1885 du bathyal des îles Prince Edouard et Marion qui correspond en fait à une Philobryidae

(cf. Bernard 1897, Melville & Standen 1907).

D'autre part, les nouvelles espèces ne semblent pas présenter d'affinités plus marquées vis à vis de certaines des autres espèces du genre *Dacrydium*, ce qui fait ressortir l'individualité de ces formes abyssales de l'océan Indien. Dans l'état actuel des connaissances, les résultats de la présente étude paraissent donc conforter l'hypothèse d'une distribution restreinte à des bassins océaniques particuliers chez la plupart des Dacrydiinae profondes (cf Knudsen 1970b, 1979; Allen 1979, 1983; Ockelmann 1983).

Il faut cependant émettre quelques réserves, compte-tenu de l'incertitude de certaines données anciennes (cf. Ockelmann 1958) et du manque de connaissances sur les différentes formes actuelles du genre (17 espèces ayant été décrites à ce jour sur un total de 35 espèces recensées).

REMERCIEMENTS

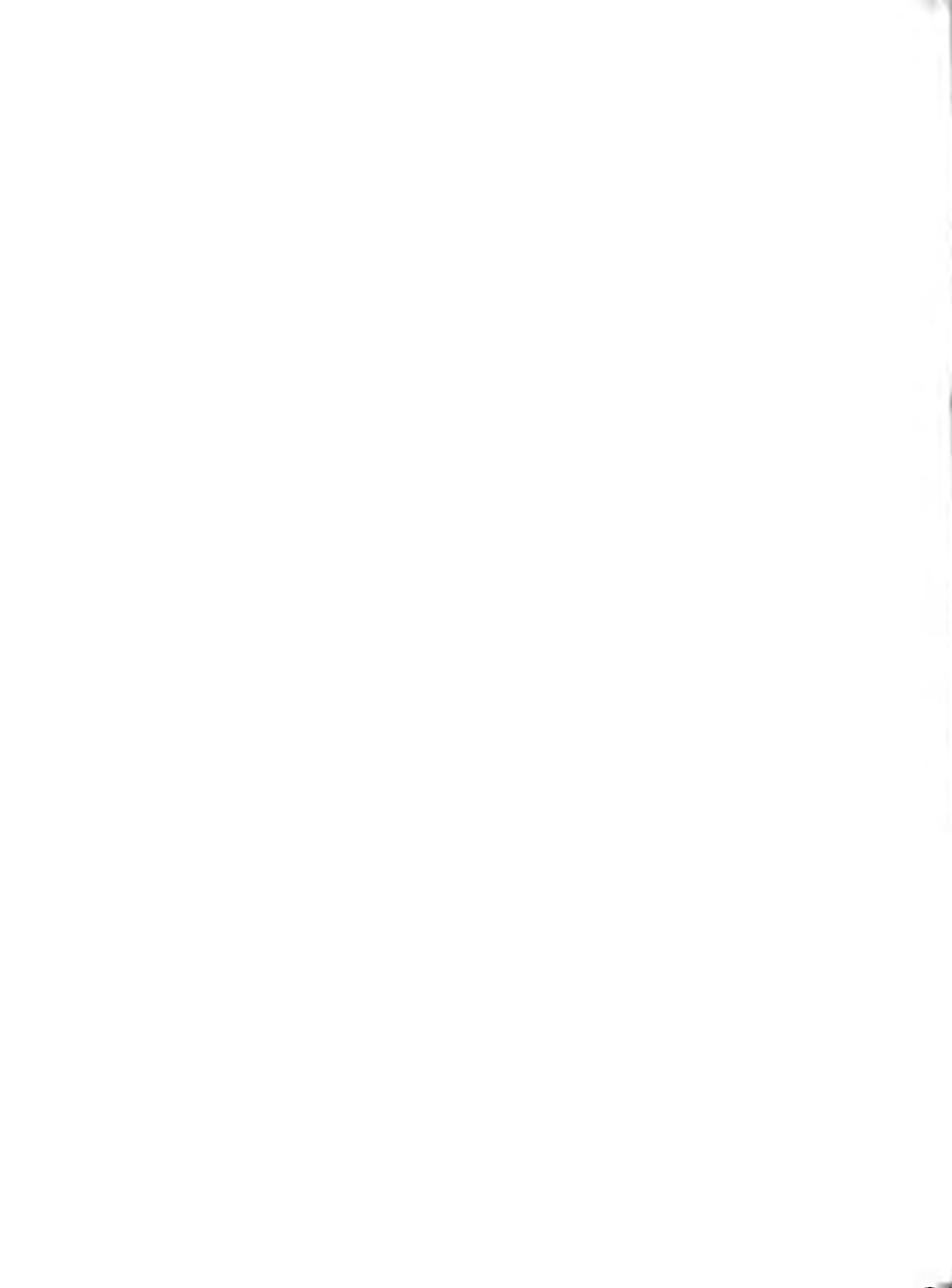
Il m'est agréable de remercier ici MM. C. Monniot, B. Thomassin et P. Bouchet pour m'avoir confié le matériel duquel proviennent ces Mytilidae, dont le tri a été pour l'essentiel assuré par le Centob de Brest; je ne saurais oublier Mr le Professeur C. Lévi, que m'a accueilli depuis plusieurs années dans son laboratoire du Museum national d'Histoire naturelle.

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DESIGNATION OF NEOTYPES OF ‘*MELANELLA ALBA* (DA COSTA, 1778)’ AND ‘*EULIMA GLABRA* (DA COSTA, 1778)’ (PROSOBRANCHIA)

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(Accepted for publication, 20th May 1989)

Abstract: Neotypes are designated for *Eulima glabra* (Da Costa, 1778) and *Melanella alba* (Da Costa, 1778) (Eulimidae Prosobranchia), and their nomenclatorial history is reviewed. This is done in order to stabilize the use of the names, for what probably are the two most well known and most often cited species of the family. New synonyms for *Melanella alba* are *Eulima porcellana* A. Adams, 1851 and *Eulima subangulata* Sowerby, 1834.

INTRODUCTION

Considerable nomenclatorial problems exist concerning the names of the two most well known British species of the family Eulimidae, ‘*Eulima glabra* (Da Costa, 1778)’ and ‘*Melanella alba* (Da Costa, 1778)’ (= *Balcis alba* (Da Costa, 1778)). These problems do not concern the use of the names in the literature or taxonomical problems with the species on which these names are based. Instead the problems are nomenclatorial and originate from poor original descriptions and references to earlier names introduced by Pennant 1777.

In order to present a more solid basis for an application to the International Commission on Zoological Nomenclature (ICZN), I will here discuss these names and select neotypes for some of the names involved.

FAMILY EULIMIDAE

EULIMA Risso, 1826.

Type species. Pending, awaiting a decision by the ICZN.

‘*EULIMA GLABRA* (Da Costa, 1778)’

?*Turbo laevis* Pennant, 1777, p. 113.

Strombiformis glaber Da Costa, 1778, p. 117.

Turbo subulatus Donovan, 1803, Pl. 172.

Helix politus: Montagu 1803, p. 398 (partim, not *Turbo politus* Linnaeus, 1758).

Helix subulatus: Montagu 1808, p. 142.

Eulima lineata Sowerby, 1834a, p. 8; 1834b, Fig. 13.

Eulima glabra: Fretter & Graham 1982, p. 411. Fig. 295.

The earliest mention that with good accuracy can be assigned to the species that presently is known in the literature as ‘*Eulima glabra* (Da Costa, 1778)’ is Donovan’s description of *Turbo subulatus* (1803). The unusually high quality of the drawing excludes confusion with any other British species of Eulimidae. This is of importance because there is one more species in

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Great Britain that has a similar colour pattern, *Eulima bilineata* Alder, 1848. That species can be distinguished from the one figured by Donovan by its smaller size (never exceeding 10 mm) and by having clearly convex whorls.

In connection with the description of *Turbo subulatus*, Donovan referred back to two older names:

1. *Strombiformis glaber* Da Costa.

For some reason Donovan did not accept Da Costa's name, despite that he was convinced about the identity. Montagu (1808) followed Donovan in this, as did all later authors, until around 1900, when the Conchological Society began to use the name *Eulima glabra* (Da Costa) in their 'List of British Marine Mollusca' (1901).

The original description of *S. glaber* is detailed enough to allow at least a tentative identification. Especially the phrase '... light horn colour, with a few slight spiral streaks' restricts the possible candidates for this name to the two species of *Eulima*. It is then much more likely that Da Costa actually possessed specimens of the species for which the name now is known, than that he had *Eulima bilineata*, a species which is very rare in shallow water.

2. 'Turbo laevis Pennant, (1777) . . . Tab. 79. upper figure?'

Pennant's description of this species is short and unspecific: 'T. (urbo) with eight smooth spires, nearly obsolete. Tab. LXXIX. . . . about a third of an inch long. Found on the shores of Anglesea.'

Plate 79 shows 8 roughly executed, unnumbered drawings of gastropods, without indication of which figure belongs to which description. Only one of them, the upper figure, is smooth and this must then be the specimen on which the name is based. This specimen can from the size (8 mm in description, 13 mm on plate), from being smooth and from the locality be identified as a culimid or as a worn specimen of *Bittium reticulatum* (Da Costa, 1778), *Rissoa membranacea* (J. Adams, 1800) or *Turritella communis* Risso, 1826 (and several other species).

If the specimen figured by Pennant had been *Eulima glabra* it is difficult to understand why he did not mention the brownish spiral bands, which were noticed by all later authors and which are very resistant to wear and remain visible also in most fossil specimens.

There is only one more species of Eulimidae that agrees with the size of the figure, viz. '*Melanella alba* (Da Costa, 1778)'. That species, however, differs markedly in shape from Pennant's figure. A 13 mm high specimen has a distinctly concave spire, and is proportionally much broader than the figure, which shows a fairly cylindrical shell.

It is thus quite obvious that any attempt to identify *Turbo laevis* will be very uncertain, and all later attempts have been marked with '?' or said to be uncertain.

I therefore find it better that the ICZN contributes to the stability of the culimid nomenclature by placing *Turbo laevis* on the Index of Rejected names instead of that it shall replace *Eulima glabra*. One of the most well known names of any culimid. If the name is not rejected, it will remain as potential threat to several other well known British gastropods.

A search in several museums in Great Britain has failed to reveal any type material of *Strombiformis glaber* or *Turbo subulatus*. In order to stabilize the use of the name *Strombiformis glaber* Da Costa, 1778, I have therefore selected a specimen, which will serve as a neotype for both these names. This is especially important since I hope it will be decided by the ICZN, that *Eulima glabra* will be designated the type species of *Eulima* Risso, 1826, a solution that will minimize nomenclatorial changes.

Neotype (*Eulima glabra* and *E. subulata*). British Museum of Natural History reg. no. 1911.10.26.28452, ex coll. Norman (Pl. 26, figs 1-2). (There exists one syntype of *Eulima lineata* Sowerby in the Swedish Museum of Natural History, reg. no. 3659.)

Type locality (*Eulima glabra* and *subulata*). South Devon, Great Britain. *Eulima lineata*, Weymouth, Great Britain.

Description. Shell tall, slender, awl shaped, solid with brownish spiral bands on an opaque, white background. Larval shell 380 µm high, with 2·5 very slightly convex, perfectly smooth whorls, not very distinctly set off from the teleoconch. Teleoconch with 10·1 perfectly flat, perfectly smooth whorls. Suture flat, almost imperceptible. Subsutural zone demarcated by a false suture and of a width corresponding to 1/4 of the height of the whorls apically, 1/5 of the height at the last whorl. Incremental scars 24 in number, rather regularly disposed along the spire, not very strong and not marked by deep furrows, except last one, which is much stronger and distinctly shows a former, thickened outer lip. Body whorl with five distinct, brown spiral bands. The most apical band actually consists of two bands, which are incompletely separated and join each other just before the outer lip via a darker blotch. The second pair of bands occupies the area from the lower suture up to the middle of each whorl and join each other via an oblique, straight line just before the outer lip. The lower pair occupies the area below the suture and is thus visible only after the outer lip, on the last half whorl. They also join each other just before the outer lip. These junctions of the two lines of each pair of bands are also repeated before each incremental scar, also the less distinct ones. The aperture is high and slender with slightly thickened, very straight outer lip and a distinct callus on the parietal wall and the columella.

Height of the shell 12·6 mm (neotype).

Remarks. The shape and the colour pattern are very constant in this species. Albinistic specimens occur, especially in more southern populations, but even there they are not common.

The host of this culimid is not known, but will very likely turn out to be a species of ophiuroid, since related species are parasitic on ophiuroids (Warén 1984a,b).

Eulima glabra inhabits sandy and muddy bottoms in depths between 10 and 100 m, from the British Isles, south to W Morocco and the Mediterranean.

Literature records of this species are usually reliable, but those from outside this area can be disregarded as erroneous.

MELANELLA Bowdich, 1822

Type species. *Melanella dufresnei* Bowdich, 1822, by monotypy.

MELANELLA ALBA (Da Costa, 1778)

Not *Turbo politus* Linnaeus, 1758, p. 767.

Not *Turbo albus* Pennant, 1777, p. 113.

Strombiformis albus: Da Costa 1778, p. 116.

Helix polita: Montagu 1803, p. 398 (not *Turbo politus* Linnaeus, 1758).

Turbo albus: Donovan 1803, p. 177.

Helix polita: Montagu 1808, p. 141.

Eulima anglica Sowerby, 1834a, p. 8.

Eulima subangulata Sowerby, 1834a, p. 8.

Eulima subangulata: Sowerby 1834b, *Eulima* sp. 11.

Eulima porcellana A. Adams, 1851, p. 276.

Melanella alba: Fretter & Graham 1982, p. 415. Fig. 298.

The first clearly identifiable description of the species known as '*Melanella* (and/or *Balcis*) *alba* (Da Costa, 1778)' is by Donovan, 1803. He figured a small specimen, 14 mm high. This size is reached only by two British culimids, *Melanella alba* and *Eulima glabra*. He has, as mentioned earlier also figured the second species, and it is no problem to interpret his figures.

In Donovan's description there are references to *Strombiformis albus* Da Costa and *Turbo albus* Pennant, the latter indicated with '?

Da Costa's description of *Strombiformis albus* is not accompanied by a figure, but the text leaves little doubt that it actually refers to the species for which the name later has been used, unless it is a tropical species, but such an assumption would make the case impossible to solve.

Both Da Costa and Donovan refer their species to *Turbo albus* Pennant, 1777. That species, on the contrary, can not be identified as *Melanella alba*. Pennant's description clearly contradicts the possibility of it being *M. alba* ('*T. (urbo)* with eight spires, striated transversely; white. Tab. LXXIX. . . about a third of an inch long. Found on the shores of Anglesea.') The plate referred to consists of 8 very coarse drawings, of which only the bottom is transversely striated. No British eulimids are transversely striated and the drawing may have been based on a worn *Bittium reticulatum* (Da Costa), *Turritella communis* Risso, 1826, *Actis minor* (Brown, 1827) or *Rissoa membranacea* (J. Adams, 1800).

Montagu (1803) identified *T. albus* Pennant with *Rissoa membranacea* (J. Adams, 1800), but later (1808) he changed this, and considered *Turbo albus* a synonym of what he had, in 1803, called *Helix polita* L. (probably inspired by Donovan 1803).

Later authors, e.g. Jeffreys (1867, p. 167) have identified *Turbo albus* Pennant with *Turbanilla lactea* (L., 1758) (Pyramidellidae). This can not be correct, since *T. albus* is described as 'transversely striated', i.e. having spiral sculpture, while *T. lactea* only has axial sculpture.

In this case, *Melanella alba* Auctorum, we thus end up with a name based on an erroneous identification, i.e. Da Costa's identification of *Turbo albus* Pennant, 1777.

The name '*Helix polita* Montagu' is based on *Turbo politus* L., 1758, another species of *Melanella* that I have recently discussed in some detail and the conclusion was that Linnaeus' use of the name differs from that of West European authors, and a neotype has been designated to stabilize this (Warén 1988).

A few more available names are *Eulima anglica* Sowerby, 1834, of which two syntypes exist in BMNH, *E. subangulata* Sowerby, 1834, lectotype, here selected BMNH 1967986 and *E. porcellana* A. Adams, 1851, lectotype, here selected, BMNH 1968298. (With typical Cumingian-Adamsian precision the two latter species were described as originating from 'Maris Indici' and 'Hab. -?'.)

We thus end up with the two following possibilities for a name of the species generally known as '*Melanella alba* (Da Costa, 1778)':

1. An application to the ICZN, that validates the use of the name *Melanella alba* (Da Costa, 1778) in the accustomed sense, by invalidating the name *Turbo albus* Pennant, 1777 and validating the name *Strombiformis alba* Da Costa, 1778.

2. Replacing '*Melanella alba* (Da Costa, 1778)' with the name *Eulima anglica* Sowerby, 1834.

The name *Melanella alba* (Da Costa, 1778) has been used invariably in a single sense, since its reintroduction by Martel (1905). The name *Eulima anglica* Sowerby, 1834, has on the other hand, not been used at all, only mentioned in a few synonyms. It must also be remembered that if alternative 2 is used, the name *Turbo albus* Pennant, 1777 will remain as a potential threat to several younger and very well established names, like *Turritella communis* Risso, 1826, *Bittium reticulatum* (Da Costa, 1778) and *Rissoa membranacea* (J. Adams, 1800).

Therefore I find alternative 1 more appealing and an application has been sent to the Commission to ask for this validation.

To give this application a more solid basis, I here designate a neotype of *Strombiformis albus* Da Costa, 1778.

Neotype. British Museum of Natural History, reg. no. 1984126, ex coll. R. Winckworth (Pl. 26, figs 3, 4).

Type locality. Plymouth, southwestern Great Britain.

Description. Shell conical, tall, slender, solid, opaque, very slightly curved and twisted. The rather cylindrical larval shell (lost in the neotype) consists of about 2 slightly convex, perfectly smooth, whorls of a height of 380 µm including an unusually blunt and rounded initial whorl. The teleconch consists of about 13 whorls, sculptured by very fine and close set axial lines, visible only in reflected light. There are also much less regular and distinct spiral lines (which may be absent) and which together with the axial sculpture give the surface a micro reticulate appearance. The apical teleoconch whorls are very flat and distinctly conical, the basal 2–4 whorls more cylindrical and convex. There are about 10, strong and conspicuous incremental scars, with intervals of 1–1.3 whorls. The subsutural zone is not well defined due to the solidity and opaqueness of the shell. The suture is shallow but conspicuous. The spire is slightly curved, due to the incremental scars, which disturb the straight axis and for each scar the spire is slightly curved, with the scar at the inside of the curvature. When the scars are aligned, i.e. 1.0 whorls apart, the spire forms an even curve, with the scars along the inside of the curve. If the scars appear with other intervals, the axis of the curvature will change and the spire gets a twisted appearance, with different directions of the curvature. The aperture is rather low and angular, with evenly rounded base. The outer lip is slightly and broadly sinuated, projecting at the suture and more projecting in its lower part. The columella and parietal wall are covered by a distinct callus.

Height of the neotype 18.3 mm.

Remarks. *Melanella alba* occurs from SW Norway, along western Europe, in the western Mediterranean and off western Morocco, usually in 10–50 m depth. It is a parasite of the holothurian *Neopentadactyla mixta* (Östergren) (Cabioc'h et al. 1978), but is also able to parasitize several other species of holothurians when starved for a few days (pers. obs.).

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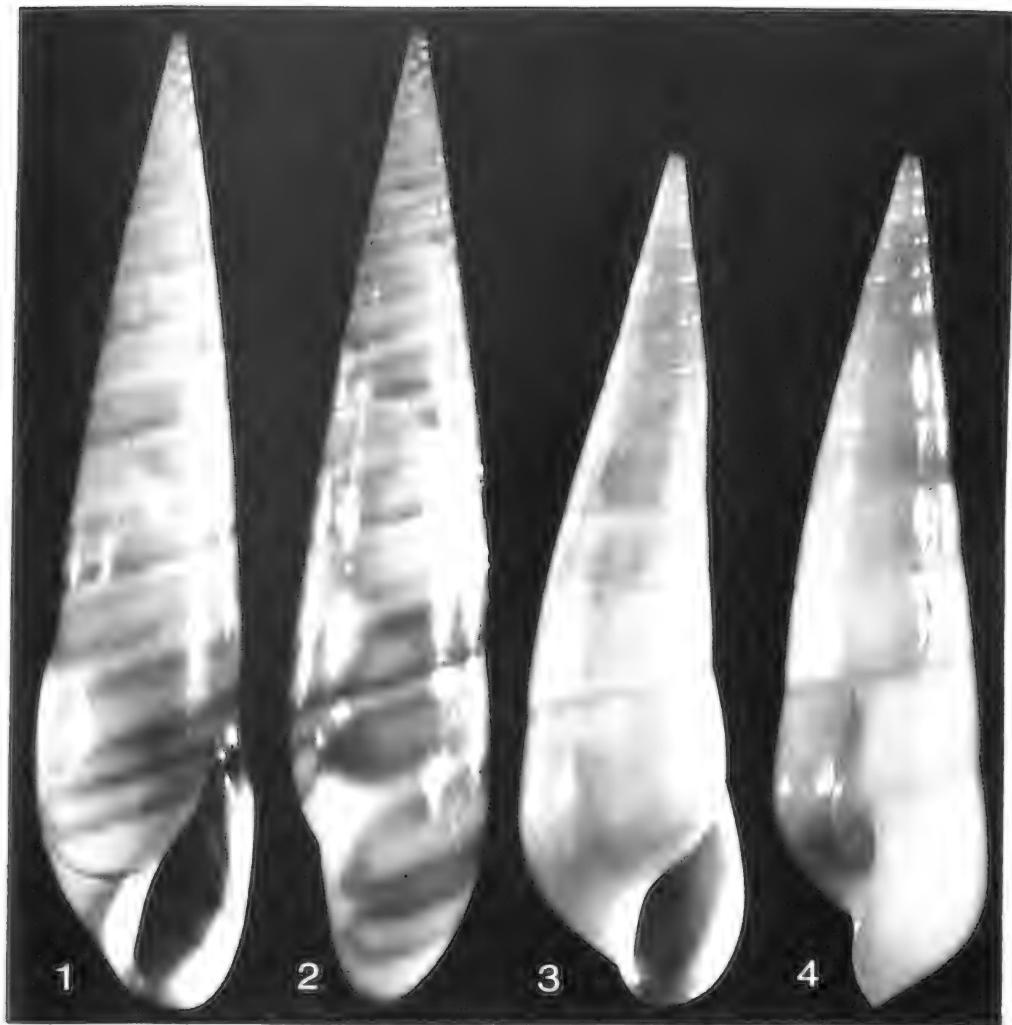


PLATE 26

Figs. 1–2. *Eulima glabra*, neotype, BMNH 1911.10.26.28452, height 12·6 mm.
Figs. 3–4. *Melanella alba*, neotype, BMNH 1984.126, height 18·3 mm.



DISTRIBUTION OF INTERTIDAL MOLLUSCS IN LAGOONAL SHINGLE (THE FLEET, DORSET, U.K.)

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Abstract: Molluscs living in shingle on the south shore of the lower Fleet, Dorset, are listed, and densities at various tidal levels are given for the commoner species. Two assemblages are described. The upper one was characterised by *Truncatella subcylindrica* and contained lower densities of *Ovatella myosotis*, *Leucophytia bidentata*, and rarely *Paludinella littorina*. The lower one occurred in areas known as 'springs' where oxygenated sea water emerged continuously. The only species common in the springs was *Lasaea rubra*, which was extremely patchy. Other species were rare, but several usually subtidal species were found there, e.g. *Emarginula conica* and *Leptochiton asellus*. Factors affecting the distribution of these species, especially their patchiness, are discussed.

INTRODUCTION

Although there are many studies on the distribution of molluscs on rocky shores (see e.g. Underwood 1979), including examinations of the crevice fauna (Morton 1954), the approach on sheltered shingle shores appears to have been limited mainly to the qualitative description of the habitats of individual species (e.g. Climo 1980). In Britain, a molluscan fauna has been described from the inner side of the Chesil Beach, which forms the seaward boundary of the contained lagoon, the Fleet, in Dorset (Seaward 1980, 1986, 1987, 1988). In this paper we attempt in a preliminary way to define the distribution of the shingle molluscs more closely, and we discuss some of the factors that might affect their distribution.

SITE DESCRIPTION AND METHODS

The physical characteristics of the Chesil Beach have been described by Carr (1981). While its south side, facing the sea, is typically exposed, mobile and more or less sterile shingle beach, in contrast the north side forms the shore of a saline lagoon, the Fleet. Here it is steep, sheltered and fairly stable, and in most places it dries out on the surface at low tide. In places, however, water emerges continuously as 'springs', possibly having percolated through the beach from the seaward side (Whittaker 1980). In these springs, water rises strongly through the shingle, and the pebbles are clean. In contrast, the space between the pebbles away from the springs is usually occupied by fine material. The surface of the stones in the springs is often covered by algae, whereas away from the springs the pebbles are usually bare. In some areas, however, weed growth is found even where there is no emerging water.

Qualitative sampling was carried out between 1977 and 1987, involving hand-sieving in

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situ, as well as direct hand collections. These studies showed considerable differences between the fauna of springs and the surrounding shingle. Further qualitative sampling was carried out on 19 May 1987 to confirm that the generalised fauna of springs and non-spring areas applied to the specific areas in which quantitative sampling was undertaken.

Quantitative sampling was carried out in an area containing one of the springs just south of the Narrows (grid reference SY660762) on 19 May 1987. Heights relative to Ordnance Datum were determined using a Zeiss NI 040A automatic level. The height survey commenced at a temporary benchmark near Smallmouth, and was completed by return to the benchmark. Overall error in the survey was 12 cm. Three transects were set up, each with 5 stations approximately 2·5 m apart on the ground. This gave a vertical height between stations of approximately 0·4 m. There are no data to allow exact correlation between Ordnance Datum and tidal fluctuations in the Fleet, but in the lower Fleet the tide probably follows approximately the levels in Portland Harbour. Here the mean levels relative to O.D. are +1·17 m (MHWS), +0·47 m (MHWN), -0·23 m (MLWN) and -0·73 m (MLWS). On the day of quantitative sampling, predicted low water was -0·43 m O.D., and our lowest sampling station was just above this at -0·37 m. Our highest station (+1·22 m) coincided roughly with a tide mark left by the last peak spring tide at +1·27 m.

One transect was in an area containing a spring. The second was in an area where the shingle had attached macrophytes but no emerging water (control 1). A third was in an area containing only bare shingle (control 2). At each station, a 3 m line was laid on the ground at right angles to the transect line, and core samples were taken at random distances along the line. Five cores were taken at each station, each of area 100 cm². Depth sampled was 20 cm except in a few cases where the shingle was encased in a solid matrix of fine sediment and penetration beyond 15 cm was not possible. Samples were returned to Bristol, kept at about 12°C, and sorted within 3 days. Fauna was then preserved in 70% alcohol. Preliminary sieving through a 5 mm mesh removed most pebbles. This was followed by washing through a 0·5 mm mesh. Final sorting and extraction of animals was carried out by hand, using binocular microscopes where necessary.

Semi-quantitative sampling from a number of spring and non-spring sites was undertaken at grid reference SY659763 (between Ferrybridge and the Narrows) on 10 November 1988, to clarify some of the differences that appeared between qualitative and quantitative surveys. At this time, samples were taken from approximately -0·4 m O.D. Six samples were taken at horizontal spacings of 2 m, three in springs and three in non-spring areas. Sample size was approximately 250 cm² × 13 cm deep. Pebbles were hand sorted at the site, the remainder sieved through 1 mm mesh, and sorted live the next day.

Salinity and temperature were measured with an MC5 bridge (Electronic Switchgear Ltd.), dissolved oxygen with a Hach meter, and pH with a Hach pH meter.

RESULTS

(a) *Habitat characteristics*

On all three transects, the top station was marked by a thick strand line, mostly of dead *Zostera* leaves. The second and third stations, in all cases, comprised bare shingle, with some fine sediment and *Zostera* detritus below the surface. At stations 4 and 5, the shingle in both the spring and control 1 transects was covered by a growth of *Enteromorpha* spp. In the spring transect, water emerged through the shingle at stations 4 and 5, and no signs of anoxia were seen. In control 1, there was no running water, and several samples were anoxic below 10 cm depth. In control 2, there was no *Enteromorpha*, and no running water, and all samples were anoxic but at variable depths (13–20 cm).

Properties of the water emerging from the spring are compared with those of open water in the Fleet just offshore, and with sea water from the south side of the Chesil Beach, in Table 1. Salinity of spring water resembled that of sea water but was higher than that of Fleet water

TABLE 1 CHARACTERISTICS OF WATER IN THE SPRING, THE FLEET AND THE SEA

	Spring	Fleet	Sea
Salinity ‰	33.2 ± 0.4 SD (n=5)	31.5 (n=1)	33.9 (n=1)
Temperature °C	13.7 ± 1.1 SD (n=5)	18.5 (n=2)	14.0 (n=1)
Oxygen mg/l (% saturation)	12.5 (145%) (n=1)	15.0 (190%) (n=1)	—
pH	8.7	9.1	—

at low tide. Temperature of spring water was similar to that of the sea. Spring water was supersaturated with oxygen, but not to the extent of Fleet water, and pH of spring water was correspondingly lower than that of the Fleet – though still well above that expected in normal sea water.

(b) Quantitative faunal sampling

The prosobranch *Truncatella subcylindrica* (I.) showed the highest mean density of all animals, and was most abundant at the highest station (Fig. 1). Maximum recorded density was 429/100 cm² in control 1, and mean density at the top station in control 1 was 162/100 cm². The patchiness of this species was emphasized by the large standard errors, and by the difference

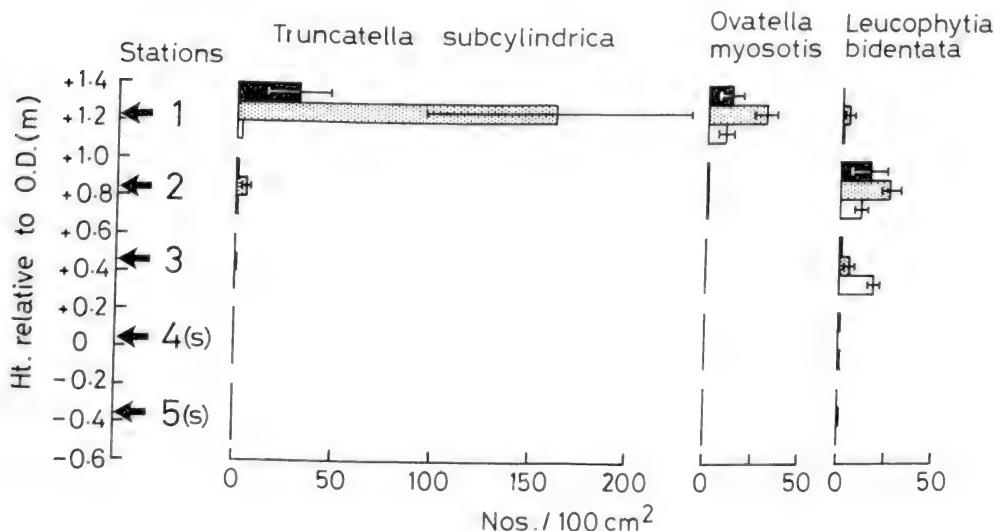


Fig. 1. Vertical distribution of *T. subcylindrica*, *O. myosotis* and *L. bidentata*.

Black bars show densities in the transect containing the spring. Stipple shows the transect with algae at low stations (control 1). White bars show the transect with bare shingle (control 2). Horizontal lines show standard errors. Thin vertical lines show no animals recorded. Thickened vertical lines show animals present but below 2/100 cm². Stations at which water emerged from the shingle on the spring transect are marked with an s.

between control 1 and control 2: mean density at the top station of control 2 was only 3·0/100 cm². A similar distribution was found for the pulmonate *Ovatella myosotis* (Drap.) (Fig. 1), although maximum density of this species in control 1 was much lower, at 46/100 cm². Both these species were essentially restricted to the top station, under a thick layer of *Zostera* detritus. Sampling 0·4 m higher on the beach was carried out only casually, since the shingle there was quite dry and clean down to 20 cm, and no animals were found. It is possible that below this depth these high-shore species may have been present. Because of the wide variations of density found (*T. subcylindrica* 0–429; *O. myosotis* 3–46), it is not possible to draw meaningful conclusions from a comparison of densities in spring, control 1 and control 2.

The pulmonate *Leucophysia bidentata* (Montagu) (Fig. 1) occurred sparsely at the highest site, but was most abundant at station 2 in the spring and control 1, and at station 3 in control 2. Maximum recorded density was 49/100 cm² (station 2, spring). The vertical range of this species extended down to low water (station 5).

The two prosobranchs *Cingula cingillus* (Montagu) and *Littorina saxatilis* (Olivi) (Fig. 2)

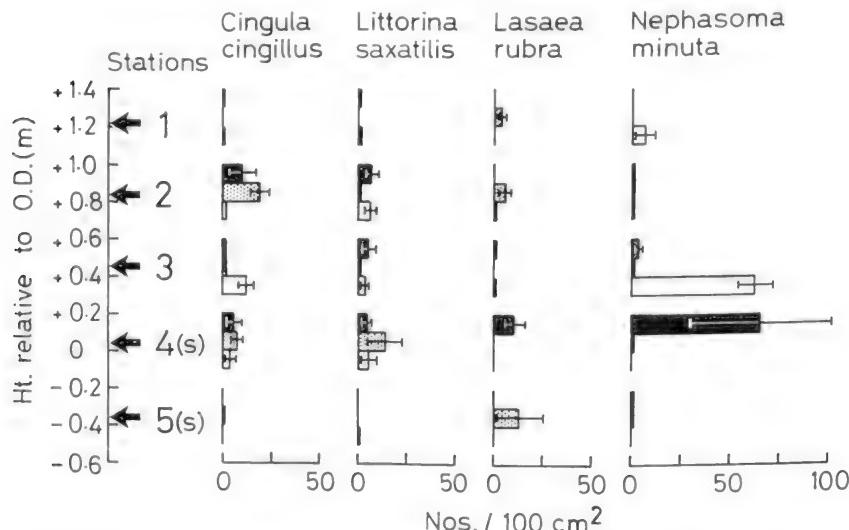


Fig. 2. Vertical distribution of *C. cingillus*, *L. saxatilis*, *L. rubra* and the sipunculan *N. minuta*. Symbols as in Fig. 1.

were both found mainly from station 2 to station 4. Maximum density of *C. cingillus* was 36/100 cm² (station 2, control 1), but in later semiquantitative sampling, densities of 64/100² were found in non-spring areas at heights equivalent to station 5 (Table 2). In both

TABLE 2 SEMIQUANTITATIVE SAMPLES (10 NOV 1988) IN 3 SPRINGS AND 3 NON-SPRING AREAS AT LOW WATER

Species	Densities (nos/100 cm ²)	
	In springs	In non-spring areas
<i>Lasaea rubra</i>	1008, 2, 252	15·6, 10, 4
<i>Cingula cingillus</i>	0, 0·4, 0	63·6, 14·8, 19·2
<i>Leucophysia bidentata</i>	0·8, 0·4, 0	0·4, 0, 1·2
<i>Onoba aculeus</i>	16, 0·4, 0	6·4, 0, 0
<i>Littorina saxatilis</i>	0, 0, 0	6, 0·8, 0

quantitative and semi-quantitative samples, *C. cingillus* was more frequent in non-spring sites, suggesting a negative correlation with springs, but more data are required to test such a hypothesis. Maximum density of *L. saxatalis* was 49/100 cm² (station 4, control 1).

The bivalve *Lasaea rubra* (Montagu) (Fig. 2) was found from stations 1 to 5, but was even more patchy in distribution than other species. Densities ranged from 0–64/100 cm². At some sites there were enormous numbers – thousands – of dead shells, with the valves closed, so that judging whether animals were alive was both difficult and time-consuming. The relatively low densities were at variance with previous experience, which indicated very high densities in spring areas. To investigate the possibility that we had underestimated numbers, either by taking samples in too restricted an area, or by failing to differentiate live and dead specimens after preservation, we took further semi-quantitative samples from spring and non-spring areas on 10 November 1988. Results are shown in Table 2. Spring areas showed densities of 2–1008/100 cm², confirming that densities can greatly exceed those found in the overall survey, but that distribution is exceedingly patchy. This contrasts with the picture in non-spring areas, where density ranged only from 4–16/100 cm². In the Fleet, the pale form *Lasaea rubra* f. *pallida* is present, rather than the more familiar red tinged typical form.

Other molluscs recorded in the cores in low densities were *Crepidula fornicate* (L.), *Bittium reticulatum* (da Costa), *Mytilus edulis* L. and *Calyptrea chinensis* (L.). Of these, *B. reticulatum* and *C. chinensis* were found only in the spring (stations 4 and 5). None were found in densities greater than 2/100 cm². Other species were recorded as dead shells only, but an account of these is deferred to the results of qualitative sampling, when they were found alive.

In summary, *L. rubra*, *B. reticulatum* and *C. chinensis* had higher densities in the spring than in the two control transects. The distribution of *T. subcylindrica*, *O. myosotis*, *L. bidentata*, *C. cingillus* and *L. saxatilis* showed no consistent relationship to the distribution of springs.

Of the other fauna found in the cores, a sipunculan (probably *Nephasoma minuta* (Kef.)) was the most abundant (Fig. 2), reaching maximum densities at stations 3 and 4 of up to 200/100 cm². The larger species *Golfingia elongata* (Kef.) was also present, but in small numbers. The isopod *Paragnathia formica* (Hesse) was commonest at station 3, with maximum densities of 17/100 m² (Overall mean at this station 5.8/100 cm² ± S.E. 1.2, n=15). Unidentified anemones were found from stations 1 to 4 with densities as high as 7/100 cm². Unidentified polychaetes were found from stations 1 to 5 with densities as high as 60/100 cm². None of these non-molluscan species showed any obvious preference for spring or non-spring areas.

(c) Qualitative faunal sampling

In addition to the mollusc species discussed above, several others have been encountered during several years of sampling. All occur at low density, and some are probably accidental or of only occasional occurrence. The more frequent require some comment. *Paludinella littoralis* (Chiaje) is a rare member of the strand line association dominated by *T. subcylindrica* and *O. myosotis*. It is a southern species, and its only current site in the British Isles is the Fleet (Light 1986). It has been found live only by hand sorting, but dead shells were common in the core samples. *Onoba aculeus* (Gould) has been recorded frequently from near low water springs (station 5) at densities up to 16/100 cm², in lower numbers at non-spring sites, and again dead shells were frequent in the core samples. *Emarginula conica* Lamarck has been recorded only from the springs. Although it occurs only in low densities, it has been found regularly. *Leptochiton asellus* (Gmelin) and *Notirus irus* (L.) have occurred on several occasions in the springs and are probably regular members of the spring fauna. The following molluscs have also been encountered alive in the springs: the prosobranchs *Skenea serpuloides* (Montagu), *Cingula semistriata* (Montagu), *Caecum armoricum* De Folin; the pyramidellids *Brachystomia eulimoides* (Hanley), *Turbanilla lactea* (L.); and the bivalves *Kellia suborbicularis* (Montagu) and *Mysella bidentata* (Montagu).

In summary, these qualitative records show that the springs contain a molluscan fauna that can be clearly distinguished from that of neighbouring non-spring areas. The species typical of springs are *Lasaea rubra*, *Emarginula conica* and *Leptochiton asellus*. Other species such as *Caecum armoricum* and *Notirus irus* may also be permanent members of the association, but are more rare. *C. armoricum*, however, is frequent to common in rather different 'springs' elsewhere in the Fleet (Seaward 1988).

DISCUSSION

The distribution of molluscs in the shingle bank of the lower part of the Fleet, including their occurrence in springs, has been discussed by Seaward (1986). He noted that there were essentially two communities present: one was typical of the upper part of the shore, above the height at which water emerged from the springs. This upper community was independent of the second community, which was restricted to the lower shore in spring areas. From a comparison of the three transects in the present investigation, it is confirmed that the density of high-shore species is not in any way related to the presence of a spring lower down the shore: spring and control areas had similar high-shore faunas. The major characteristic of these high-shore assemblages was their patchiness, and densities of individual species varied by two orders of magnitude over short distances. The cause of this patchiness, as in other cases (e.g. Dayton 1984), is uncertain. One possibility is that it relates to the abundance of detritus which is probably the major food source at the top of the shore. From a purely subjective assessment, however, this was not apparent. Patchiness is unlikely to be related to larval recruitment, since none of the upper shore species has free-living larvae (*T. subcylindrica* – Fretter & Graham 1978a; *O. myosotis*, *L. bidentata* – Morton 1955a; *C. cingillus* – Fretter & Graham 1978b; *L. saxatilis* – Fretter & Graham 1980; *L. rubra* – McGrath & O Foighil 1986). A more likely hypothesis is that patchiness is related to the mobility of the shingle. On the upper shore, shingle is moved by tides and waves, especially in storms, and shore profiles are probably quite variable. Since all the molluscs concerned are small, erosion of the top shingle layers could lead rapidly to mortality from desiccation, or from crushing when the shingle moves.

The assemblage of molluscs within the spring differed from that on the upper shore in that densities of most species were very low. The only species that were at all common were *C. cingillus*, *L. saxatilis* and *L. rubra* – the latter occasionally in very high densities. None of the other spring molluscs was abundant enough to be sampled by the cores. This rarity may at least partly relate to the lack of food supply. While the upper shore contained abundant *Zostera* detritus, very little organic material was apparent in the spring. Certainly the pebbles were much cleaner than in the non-spring areas, where they are partly cemented together by brown muddy deposits. Nevertheless, the spring contained a unique assemblage of species, and there may be organic supplies that we have not detected. This assemblage is presumably dependent upon the permanent flow of water, which essentially provides a 'sublittoral' habitat (Seaward 1986): *E. conica* and *L. asellus* at least, are usually found subtidally elsewhere (Fretter & Graham 1976, Jones & Baxter 1978), although we have no information about *C. armoricum*. The water emerging from the spring is very similar in temperature and salinity to sea water on the south side of the Chesil Beach, supporting the suggestion by Whittaker (1980) that it percolates through the shingle ridge. Yet it has a high oxygen content, and therefore presumably does not have a long residence time within the ridge. This high oxygen content and its low temperature provide an ideal environment for subtidal molluscs.

We have not been able to find any account in the literature describing equivalent

assemblages of molluscs in a sheltered shingle environment. The upper-shore assemblage, however, bears a strong resemblance to that described by Morton (1954) for rocky crevices at Wembury (South Devon) and by Glynne-Williams & Hobart (1952) for rock crevices on Anglesey. These crevices contained abundant *L. rubra*, *L. bidentata*, *C. cingillatus* and *L. saxatilis*, with occasional *Mytilus edulis* and *C. semistriata*. They lacked *T. subcylindrica*, *O. myosotis* and *P. littorina*, but of these *T. subcylindrica* and *P. littorina* are essentially Mediterranean species (Fretter & Graham, 1978a), and are very scarce in Britain, being at their northern limit. The presence of *O. myosotis* in the Fleet, but not on the shores referred to above, is harder to understand. It has, in fact, been found deep in crevices on some shores in Anglesey (Kensler 1967), but its centre of distribution is in saltmarshes (Morton 1955b), and it is not normally found on hard substrata. It has been recorded in the outlet tunnel of a lagoon in Cornwall (Swanpool, Falmouth) on solid rock (Barnes et al. 1971). In that case the tunnel provided a constant high humidity, and it may be that desiccation is a major factor limiting its spread on rocky shores. Morton (1954) suggested that high humidity and the presence of a detrital food source were major factors in regulating crevice faunas, and this is probably true of the shingle fauna described here.

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JOURNAL OF CONCHOLOGY, VOL. 33, NO. 4

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PORtUGUESE SLUGS. II. *DEROCERAS NITIDUM* AND THE *DEROCERAS LOMBRICOIDES* GROUP OF FORMS. (GASTROPODA: PULMONATA: AGRIOLIMACIDAE)

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Abstract: Morelet and Simroth described four species of Portuguese agriolimacids: *Deroberas nitidum* (Morelet, 1845), *Deroberas lombricooides* (Morelet, 1845), *Deroberas maltzani* (Simroth, 1885) and *Deroberas immaculatum* (Simroth, 1891). On account of its anatomical similarity (rectum with no caecum, penis with caecum, terminal penial gland and posterior spheroid bulge), Wiktor and Castillejo considered that *Deroberas hispaniensis* Castillejo & Wiktor, 1983 is a synonym of *D. lombricooides*. Examination of 588 specimens of this group of forms, including paratypes and topotypes of *D. hispaniensis*, we conclude that *D. nitidum* and *D. maltzani* are the same species; and that the stimulators of the topotypes of *D. lombricooides* are horseshoe-shaped, those of *D. immaculatum* flat folds and those of *D. hispaniensis* ring-shaped. It is very difficult to distinguish between *D. immaculatum* and *D. lombricooides* on purely anatomical grounds, since stimulators with intermediate shapes have also been found. If the shape of the stimulator really is a taxonomically relevant characteristic, *D. hispaniensis* is a valid species.

Resumen: Morelet y Simroth describieron cuatro especies de Agriolimácidos en Portugal: *Deroberas nitidum* (Morelet, 1845), *Deroberas lombricooides* (Morelet, 1845), *Deroberas maltzani* (Simroth, 1885) y *Deroberas immaculatum* (Simroth, 1891). Debido al parecido de la anatomía: recto sin ciego, con un abultamiento esférico posterior, ciego y glándula peneana terminal, Wiktor y Castillejo consideraron a *Deroberas hispaniensis* Castillejo et Wiktor, 1983 como una sinonimia de *D. lombricooides*. Despues de estudiar 588 ejemplares de este grupo de formas, de revisar paratipos y topotipos de *D. hispaniensis*, se llega a la conclusión que *D. nitidum* y *D. maltzani* son la misma especie, que el órgano estimulador de los topotipos de *D. lombricooides* tiene forma de herradura, el de los de *D. immaculatum* de pliegue plano y el de los de *D. hispaniensis* forma de anillo. Con criterios anatómicos puros es muy difícil separar *D. immaculatum* de *D. lombricooides* ya que se han encontrado órganos estimuladores intermedios, y si realmente el órgano estimulador tiene valor taxonómico, *D. hispaniensis* es buena especie.

INTRODUCTION

In the nineteenth century, four Portuguese agriolimacids were described whose genitalia all exhibited a caecum near a terminal or subterminal penial gland and a posterior glandular cap: *Deroberas nitidum* (= *Limax nitidus*) (Morelet, 1845); *Deroberas lombricooides* (= *Limax lombricooides*) (Morelet, 1845); *Deroberas maltzani* (= *Agriolimax maltzani*) (Simroth, 1885); and *Deroberas immaculatum* (= *Agriolimax immaculatus*) (Simroth, 1891). The same penial characteristics also occur in a species recently encountered in Galicia (Spain) and likewise found in Portugal, *Deroberas hispaniensis* Castillejo & Wiktor, 1983.

Morelet (1845) created the species name *D. nitidum* for agriolimacids he had collected in Lisbon and Beja, and *D. lombricooides* for those collected in Monchique and Braga. Both descriptions involved only external morphology. On reviewing the anatomy of these species, Simroth (1885, 1891) distinguished taxonomically between the Monchique and Braga

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specimens, reserving the name *D. lombricoides* (Morelet, 1845) for those from the hills around Braga and creating the name *D. maltzani* (Simroth, 1885) for those from Monchique. He also introduced the name *D. immaculatum* (Simroth, 1891) for a species found near Sintra for which he later published further anatomical details after encountering a dark variety at Portunhos (Simroth, 1893).

For many years the above species were ignored or their names treated as synonyms of others. Taylor (1907), for example, considered *D. lombricoides* (Morelet, 1845) to be identical to *D. laeve* (Müller, 1774) and completely overlooked Simroth's work. The same attitude was adopted by Nobre (1930, 1941), who failed to take *D. nitidum*, *D. maltzani* and *D. immaculatum* into account, and included *D. lombricoides* (Morelet, 1845) among the synonyms of *D. laeve* (Müller, 1774) (though adding that 'according to some naturalists it is hardly more than a variety of *A. agrestis*').

In creating the name *D. hispaniensis* for a species found in Spain, Castillejo and Wiktor (1983) stated that its genitalia resembled those of *D. lombricoides* as restricted by Simroth (1891) (*D. lombricoides* (Morelet, 1845, Partim!)), which Castillejo *et al.* (1984) redescribed on the basis of topotypes collected at Sameiro (Braga). Finally, on examination of part of the material used in the present study, Wiktor and Castillejo (1987) relegated *D. immaculatum* and *D. hispaniensis* to the status of synonyms of *D. lombricoides* and redescribed *D. maltzani* (Simroth, 1885), which had only shortly before been redescribed by Rahle (1983) on the basis of seven specimens collected at Barranco dos Pisoés in the Algarve.

MATERIAL

Systematic, periodic sampling of Portuguese malacological fauna carried out between April 1983 and June 1986 by the soil biology group of the Biology Faculty, University of Santiago de Compostela (Spain) yielded 588 agriolimacids possibly belonging to the species mentioned above as described by Morelet and Simroth. Localities covering as much of Portugal as possible were sampled, including, where possible, those mentioned by Morelet (1845) and Simroth (1885, 1891, 1893). Most of the material examined has been deposited in the Department of Animal Biology of the University of Santiago, Spain. Specimens sent for confirmation by Dr. Wiktor (Wroclaw, Poland) and Dr. Giusti (Siena, Italy) are deposited in their private collections.

HISTORICAL NOTES

In order for the reader to understand the taxonomical problems of the species discussed in this article, we briefly review here the anatomical descriptions given by previous authors. The taxa are discussed in chronological order, but modern genus names are used.

Deroceras nitidum (Morelet, 1845)

References: Morelet, (1845), p. 35 (*Limax nitidus* sp. nov.); Simroth (1891), Pl. 3, fig. XVIII (*Agriolimax nitidus* Morelet).

Morelet (1845) described *D. nitidum* as 'glossy black' in colour and almost the same as *Milax gagates* (Draparnaud, 1801) in size. Simroth (1891), who found this species in Abrantes and Calcilhas, reported that 'the digestive tract is exactly the same as in *D. lombricoides*: the rectum has no caecum, but there is a suggestion of posterior separation. Penis with a short blind sac at its tip, penial gland with few ramifications, and a large stimulating organ inside

Deroceras lombricoides



Fig XI

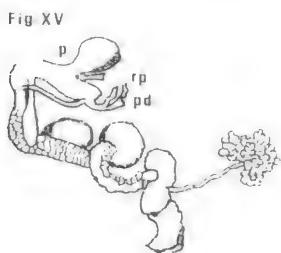


Fig XV



Fig XVI_a

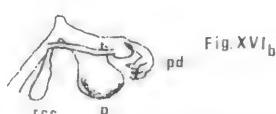


Fig XVI_b

Fig XII



Fig XIII



Fig XIV



Deroceras immaculatum

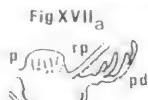


Fig XVII_a



Fig XVII_b

Fig XIX



Deroceras nitidum

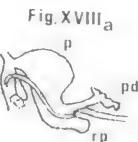


Fig XVIII_a



Fig XVIII_b

Plate 3 from Simroth (1891) (in part). Figs. XI–XVI_b, *D. lombricoides*. Figs. XVIIa, XVIIb and XIX, *D. immaculatum*. Figs. XVIIIa and XVIIIb, *D. nitidum*.

whose position is shown in Figure XVIIIb of Plate 3'. According to the figure mentioned (Simroth (1891), Pl. 3, fig. XVIIIb), the stimulator has the shape of an elongated cone. He referred to this organ again when, in discussing *D. maltzani*, he says that 'in the penis of this species there is a stimulating organ as long as that of *D. nitidum*'.

***Deroceras lombricoides* (Morelet, 1845, Partim!)**

References: Morelet (1845), p. 39, Pl. III, fig. 4 (*Limax lombricoides* sp. nov.); Simroth (1891), p. 84, Pl. 3, figs. VII and XI–XVI (*Agriolimax lombricoides* Morelet).

Morelet (1845) described *D. lombricoides* as 'very similar in colour and form to *D. agreste* (Linneo, 1758) . . . the predominant colour is that of the earthworm . . . Common in the neighbourhood of Monchique, and a darker variety inhabits the hills of Braga'.

Simroth (1891) writes 'I assume the slugs from the north (the Braga hills) to be *D. lombricoides*, whose territory I extend to the following localities: Coimbra, Playa d'Espinho, Oporto, Mattosinhos and Gerês'. In discussing the internal anatomy of the species he says that he only notes distinctive characteristics 'since the remainder coincide with the general structure of the genus. There is no appendix in the rectum . . . As regards the genitalia, 'the penis has a well-ramified penial gland like *D. agreste* [*D. reticulatum*], but it has no stimulating organ; nor is the penial gland normally at the distal [proximal] tip, but in front of a short terminal caecum where the vas deferens ends. Inside, instead of a stimulating organ, there is a high, comblike, many-pleated crooked fold whose variable position gives the penis widely differing outlines'.

Writing of copulation, he states that 'they take up positions next to each other forming a circle; from the genital orifice they produce, as stimulating organ, a thick, flat triangular lip. With these lips they push each other's backs vigorously, and from time to time they move round (Pl. 3, fig. XI)'. A few lines later he adds that he 'found a pair of them in Oporto . . . first they moved round slowly . . . , then they kept still . . . , again they came together . . . , again they moved round . . . ', and that 'during all this time the stimulating organ remained pressed against the mate . . . '. Simroth quickly places these two *Deroceras* in alcohol, upon which they strongly retracted their stimulators, but on a different occasion he observed the evagination of 'a kind of bare spoon that was round outside (Pl. 3, fig. XIV . . .)'. Most curiously, he states that 'at the tip of the evaginated part (Pl. 3, fig. XIVa)' can be seen 'epithelial formations different from the remainder' which he considers to be 'peculiar stimulating structures'. Figs. XI and XII of Pl. 3 are said to correspond to different individuals; those represented in fig. XII of Pl. 3 had 'only two small whitish vesicles that gripped each other hard', and this is insisted on when he adds that 'the orifices must correspond to these vesicles . . . '.

***Deroceras maltzani* (Simroth, 1885)**

(= *D. lombricoides* (Morelet, 1845, Partim!))

References: Simroth (1891), p. 90 (*Agriolimax Maltzani* Simroth); Rähle (1983), p. 191, Abb. A–H (*Deroceras maltzani* Simroth, 1885); Wiktor & Castillejo (1987), p. 14, Figs. 4 and 5 and Photograph 2 (*Deroceras (Agriolimax) maltzani* Simroth, 1885).

According to Simroth (1891), the specimens he collected near Monchique were grey or reddish-grey, with lightly mottled backs. He adds that 'Morelet . . . found them and characterized them correctly, but muddled them with *lombricoides* from northern Portugal . . . Certainly, they both lack any caecum in the rectum, but in the penis there is a stimulating organ as large as in *nitidum*'. He then notes that the proximal part of the penis features a very slightly ramified penial gland near a caecum that he had not mentioned previously (Simroth, 1885). This description is almost exactly the same as his description of *D. nitidum*, the only difference being the colour of the body.

Rähle (1983) redescribed this species on the basis of 7 specimens collected by Jens

Hemmen in June 1983 at Barranco dos Pisos (Monchique, Algarve). The genitalia of specimens from the Serra de Monchique were again portrayed by Wiktor and Castillejo (1987). The copula of two specimens from Cabo de São Vicente is described by Castillejo *et al.* (1987).

Deroceras immaculatum (Simroth, 1891)

References: Simroth (1891), p. 86, Pl. 3, figs. IX, X, XVII and IXX (*Agriolimax immaculatus* n. sp.).

According to Simroth (1891), this species is outwardly difficult to distinguish from *D. lombricoides*, since both have very similar colouration. He himself confessed to having 'mistaken it for the latter (*D. lombricoides*) when observing it in the wild, just as Morelet appears to have done', and he adds that *D. immaculatum* too is 'earthworm-coloured . . . or even black'. He presumably gave it the name *immaculatum* because, according to him, 'dorsal spots are always lacking'.

As regards internal anatomy, Simroth states that 'the differences with respect to *D. lombricoides* are few but constant. The penis has the same penial gland, but no terminal blind sac' (though in describing the variety *nigrescens* he does mention the existence of a penial caecum). Writing of the stimulator, or as he calls it, the 'fold', he states that it is 'considerably smaller; the figures (Pl. 3, figs. XVIIa, and b) show the maximum degree of development'. He then mentions that there is a suggestion of a caecum in the rectum, but no more, and closes his remarks on the rectal caecum opining that 'the existence or otherwise of a caecum in the rectum cannot be used to group the agriolimacids in two sub-genera'.

Simroth appears not have been completely convinced as to the validity of this species, for he emphasizes that 'since the differences between them are so slight, it might be feasible to consider *immaculatum* as just a variety of *lombricoides*; certainly the two are very homogeneous . . . but I nevertheless consider . . . that the differences in the penis rule out a cross between the two forms, which is sufficient to make *immaculatum* a slug that is constant within its circle of forms, i.e. a species apart'.

Deroceras hispaniensis Castillejo & Wiktor, 1983

References: Castillejo and Wiktor (1983), p. 11, Figs. 26–32 (*Deroceras (Plathystimulus) hispaniensis* n. sp.).

According to Castillejo and Wiktor (1983), the male part of the genitalia of this species has a caecum near the penial gland, a posterior spherical swelling and a membranous stimulator shaped like a U with the open end towards the anterior penis.

RESULTS

We here redescribe, under the appropriate name, each of the species which we consider may currently be distinguished; subgenera are not considered.

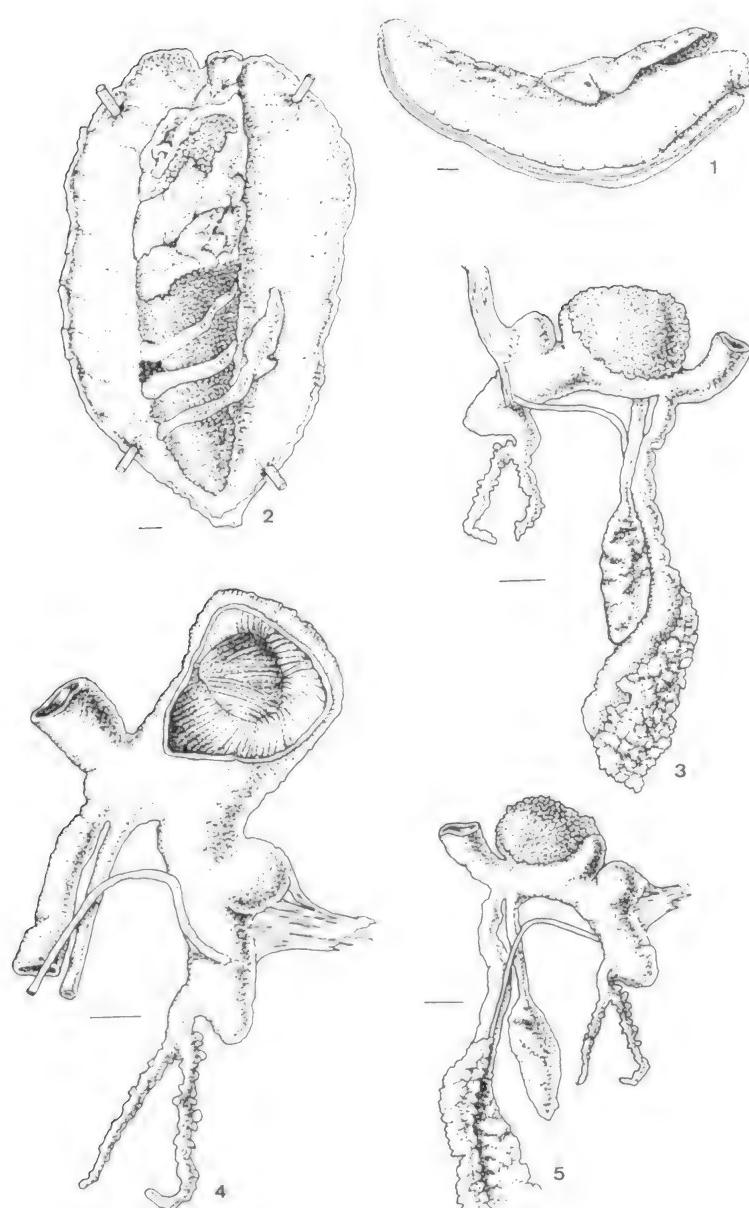
Deroceras nitidum (Morelet, 1845)

Synonyms: *Deroceras lombricoides* (Morelet, 1845, Partim!); *Deroceras maltzani* (Simroth, 1885).

Description

Length 35 mm live, 25 mm in 70° alcohol (Fig. 1). Body colour varying between light brown and all black. Body and sole mucus colourless.

Organs in situ (Fig. 2). The topography of the organs is the same as in other species of the genus. The conjunctive tissue about the visceral sac has black pigmentation in black



Figs. 1-5. *Deroceras nitidum* (Morelet, 1845).
Allere (UTM 29SNB34). 1: side view. 2: organs *in situ*. 3 and 5: genitalia. 4: stimulator *in situ*. Scale 1 mm.

specimens and is colourless in brown ones.

Gentialia (Figs. 3–5). The ovotestis, hermaphrodite duct, oviduct, albumin gland and spermiduct all conform to the typical topography of the genus. The proximal penis exhibits two caecum-like protuberances, one at the proximal end and one more centrally, near the insertion of the retractor muscle. Penial gland subterminal, with two festooned branches (sometimes just one). Distal penis with a spheroid protuberance covered by a cap of glandular appearance. Vas deferens short and narrow, oviduct shorter still. Copulatory sac ovoid, pyriform, with a short duct leading to the neighbourhood of the genital atrium. The stimulator located inside the distal penis is conical, pyramidal or a flattened cone and is normally greater in breadth than height (sometimes the vertex is blunt), but during copulation it is greater in height than breadth and has a ball-like tip.

Copulation (Figs. 6–14). During copulation, mating pairs stimulate each other in a distinctive fashion by presenting their stimulators one opposite the other (Figs. 6 and 10) and using them to stroke the mate's flanks (Figs. 8, 9, 11), the two kinds of stimulus being repeated several times in turn before exchange of sperm takes place (Fig. 12). Immediately after sperm exchange, each individual begins slowly to chase its own tail; the penis can be seen to be completely evaginated, and each animal covers itself in a watery secretion before they finally move off in different directions (Figs. 13, 14). The photographs shown here were taken on December 4th 1984 at Cabo de Sao Vicente (Portugal). We have observed other copulations, likewise in Portugal, at Caldas de Monchique (4–XII–84) and Alferce (21–IV–85). We have observed no precopulatory courting behaviour because all three copulations were chanced upon when in progress.

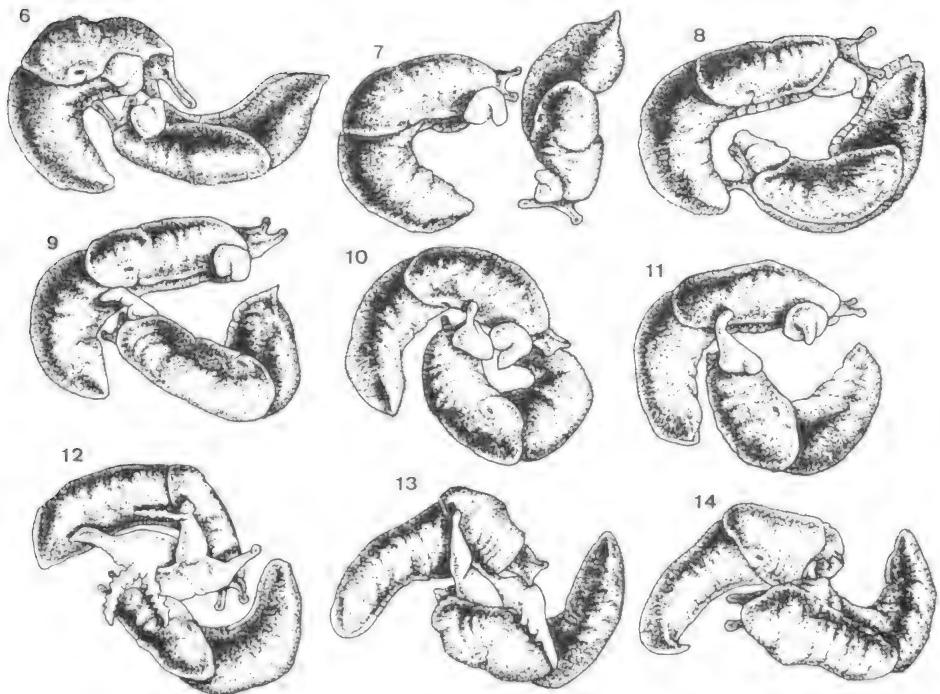
*Material examined** (Fig. 15)

Marmelete (29SNB23, Monchique), 12–IV–84, leg. J. Castillejo (29). Caldas de Monchique (29SNB32), 15–IV–84, leg. T. Rodríguez (24). Alferce (29SNB43, Monchique), 16–IV–84, leg. A. Outeiro (24). Monchique (29SNB33), 16–IV–84, leg. T. Rodríguez (9). Carretera Monchique–Foia (29SNB32), 16–IV–84, leg. J. Castillejo (24). Barranco do Velho (29SNB92, Serra do Caldeirao), 30–XI–84, leg. A. Outeiro (6). Ameixal (29SNB93, Serra do Caldeirao), 1–XII–84, leg. J. Castillejo (4). Alportel (29SNB91, Serra do Caldeirao), 1–XII–84, leg. T. Rodríguez (2). Barranco do Velho (29SNB92, Serra do Caldeirao), 1–XII–84, leg. A. Outeiro (3). Monchique (29SNB33), 2–XII–84, leg. J. Castillejo (11). Alportel (29SNB91, Serra do Caldeirao), 2–XII–84, leg. A. Outeiro (3). Cabo de Sao Vicente (29SNA09, Sagres), 3–XII–84, leg. T. Rodríguez (14). Figueira (29SNB20, Lagos), 3–XII–84, leg. J. Castillejo (13). Sagres (29SNA09), 3–XII–84, leg. T. Rodríguez (5). Vila do Bispo (29SNB00, Lagos), 3–XII–84, leg. A. Outeiro (11). Santiago do Cacém (29SNC20), 21–III–85, leg. T. Rodríguez (9). Alferce (29SNB43, Monchique), 21–III–85, leg. J. Castillejo (21). Vila do Bispo (29SNB00, Lagos), 21–III–85, leg. A. Outeiro (1). Foia (29SNB32, Monchique), 2–VI–85, leg. A. Outeiro (9). Outao (29SNC06, Serra da Arrabida), 25–I–86 and 28–III–85, leg. T. Rodríguez (4).

Discussion

There are good grounds for considering *D. maltzani* (Simroth, 1885) (= *D. lombricoides* (Morelet, 1845, Partim!)) to be identical to *D. nitidum* (Morelet, 1845). Morelet (1845) found *D. nitidum* in the neighbourhood of Lisbon and Beja and described it as being the same colour as *M. gagates*, i.e. black. Simroth (1891) reported finding it in Alvega (Abrantes) and Cacilhas (Almada). Sampling of the Abrantes area has failed to locate *D. nitidum* (Morelet, 1845) but has afforded specimens of *D. lombricoides* (Morelet, 1845, Partim!) (= *D. immaculatum* (Simroth, 1891)) whose stimulators projected partially towards the vagina; the

*Numbers in brackets following each locality refer to the number of specimens studied.

Figs. 6–14. Copulation of *Deroceras nitidum* (Morelet, 1845).

Cabo de São Vicente (UTM 29SNA09). 6–11: reciprocal stimulation. 12: exchange of sperm. 13 and 14: separation. In the stimulation phase only the stimulator is evaginated. The penial gland is protracted during sperm exchange. Without scale.

only species found in the Serra da Arrábida, near Cacilhas, was *D. maltzani* (Simroth, 1885).

According to Simroth's (1891) description of the two species, *D. nitidum* has a penis with 'a short caecum at the tip, a little-ramified penial gland and, inside (the penis), a long stimulating organ whose position is shown in Fig. XVIIIb of Plate 3'. In describing *D. maltzani* he states that the penis contains 'the same long stimulating organ as in *D. nitidum*, as well as a little-ramified penial gland at the tip', and he goes on to add that there is also a penial caecum that he had not described previously. To our mind there is therefore no doubt that the two forms are one and the same species, since they have the same penial topography and identical stimulators, the only difference between them being the colour of the body.

It was quite probably their different colouration, together with the different altitudes at which he found them, that gave rise to Simroth's confusion, since he states that '*D. maltzani* is a lighter type found in coastal mountains, and *D. nitidum* a black form belonging to meadows and fields'. For Simroth, all black *Deroceras* were, in the absence of further evidence, *D. nitidum*, though he might later assign them to some other species on examination of their internal anatomy. Thus on finding a black variety of *D. immaculatum* in Portunhos he wrote that 'on account of the colour I was unsure whether it was *Deroceras nitidum* (Morelet, 1845) or *immaculatum*'. Our own experience of the Monchique populations of *D. maltzani* (Simroth, 1885) is that melanism is induced by proximity to water; totally black individuals are found in the same area as others of a light brown colour depending on whether their local habitat is

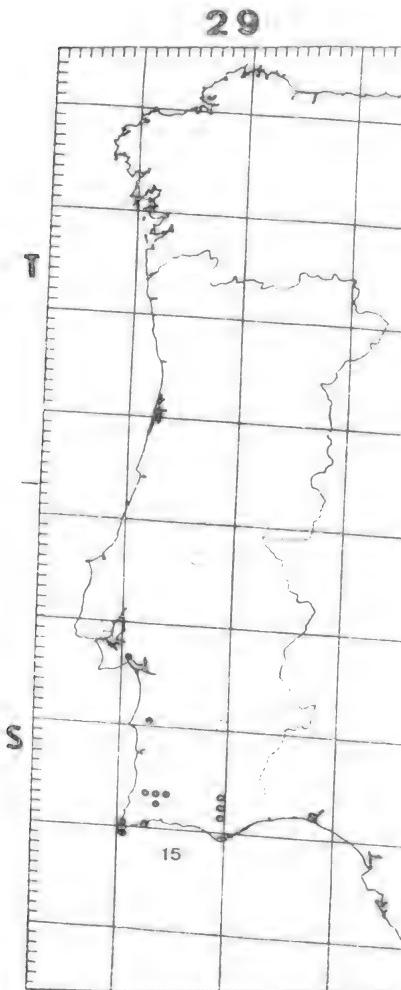


Fig. 15. Map of localities in which *Deroceras nitidum* (Morelet, 1845) has been found. Scale 100 km.

wet or not. In the light of these considerations, Figs. XVIIa and b of Simroth's (1891) Plate 3 may be recognized as agreeing perfectly with the drawings of *D. nitidum* published by Simroth himself (Simroth, 1891) and with the drawings of *D. maltzani* published by Rähle (1983) and Wiktor and Castillejo (1987). We accordingly believe that *D. maltzani* is identical to *D. nitidum*, and that its valid name, for reasons of priority, is *Deroceras nitidum* (Morelet, 1845).

It is worth pointing out that, at first sight, *D. immaculatum* (Simroth, 1891) can sometimes be taken for *D. nitidum*; we have found typical populations of *D. immaculatum* to contain specimens whose stimulator appeared to be more or less conical because it was folded

towards the vagina, which we attribute to intraspecific variation and/or to deformation caused by the contraction of the penial muscle during death by asphyxia.

Deroceras lomb ricoides (Morelet, 1845)

(= *Deroceras lomb ricoides* (Morelet, 1845, Partim!))

Synonyms: *Deroceras immaculatum* (Simroth, 1891).

Description

Length 30 mm live, 24–26 mm in 70° alcohol (Figs. 16, 21). Body brown, sometimes with dorsal spots that become darker and smaller in alcohol. Body and sole mucus colourless. *Organs in situ* (Figs. 17 and 22). The organs of the specimens studied exhibit the characteristic topography of the genus. Rectum with no caecum.

Genitalia (Figs. 18–20, 23–29). The ovotestis hermaphrodite duct, albumin gland and spermiduct have the topography typical of the genus. Proximal penis broad and cylindrical, with a subterminal caecum; distal penis with a bulge or spheroid mass of which the superior part is covered by a glandular structure that in some specimens forms a crest and in others is horseshoe-shaped or forms an oval cap. Penial gland terminal, with 4–6 festooned branches of variable length. The short, subterminal retractor penis is inserted near the penial caecum. Vas deferens short, emerging between the penial gland and the retractor penis. The internal wall of the penis is covered in narrow striae and exhibits a fold giving rise to the subterminal anterior caecum. The stimulator is located in the spheroid mass and its shape is related to that of the latter's associated glandular covering; specimens with glandular structures in the shape of crests or oval caps have stimulators in the shape of a flat fold (Figs. 23, 25, 26), while those with horseshoe-shaped glandular structures have horseshoe-shaped stimulators too (Figs. 19 and 20). In both cases the stimulator is shrouded in fibrous projections from the base of the glandular structure.

Material examined (Fig. 31)

Specimens with flat folds for stimulators (= *D. immaculatum* (Simroth, 1891)). Sabugueiro (29TPE17, Serra da Estrela), 28–III–83, leg. J. Castillejo (4). Constancia (29SND57, Abrantes), 19–IV–84, leg. J. Castillejo (5). Constancia (29SND57, Abrantes), 31–V–86, leg. J. Castillejo (1). Constancia (29SND57, Abrantes), 20–IV–84, leg. T. Rodríguez (7). Luso (29TNE56, Coimbra), 21–IV–84, leg. A. Outeiro (2). Ança (29TNE45, Coimbra), 22–IV–84, leg. J. Castillejo (21). Luso (29TNE56, Coimbra), 23–IV–84, leg. T. Rodríguez (16). Montemor-O-Novo (29SNC67), 25–III–85, leg. A. Outeiro (3). Vendas Novas (29SNC48, Montemor-O-Novo), 25–III–85, leg. A. Outeiro (5). Luso (29TNE56, Coimbra), 28–III–85, leg. J. Castillejo (4). Caxarias (29SND49, Fátima), 18–VI–85, leg. J. Castillejo (3). Vila Nova de Ourem (29SND39, Fátima), 19–VI–85, leg. T. Rodríguez (2). Caxarias (29SND49, Fátima), 19–VI–85, leg. A. Outeiro (4). Castelo Branco (29SPE21), 21–VI–85, leg. J. Castillejo (1). Luso (29TNE56, Coimbra), 24–XI–85, leg. T. Rodríguez (3). Constance (29TNF75, Penafiel), 3–XII–85, leg. J. Castillejo (11). Pes de Pontes (29TNF70), Serra do Caramulo), 10–XII–85, leg. T. Rodríguez (3). Vouzela (29TNF70, Serra do Caramulo), 10–XII–85, leg. T. Rodríguez (2). Crescido (29TNF80, Serra do Caramulo), 11–XII–85, leg. A. Outeiro (7). Luso (29TNE56, Coimbra), 11–XII–85, leg. J. Castillejo (1). Marco de Canaveses (29TNF75, Penafiel), 12–XII–85, leg. A. Outeiro (1). Agrela (29TNF75, Marco de Canaveses), 13–XII–85, leg. J. Castillejo (13). Marco de Canaveses (29TNF75, Penafiel), 13–XII–85, leg. T. Rodríguez (5). Lagoa Azul (29SMC69, Sintra), 26–I–86, leg. A. Outeiro (4). Lagoa Azul (29SMC69, Sintra), 27–I–86, leg. T. Rodríguez (4). Luso (29TNE56, Coimbra), 28–I–86, leg. A. Outeiro (1). Pereira (29TNE24, Montemor-O-Velho), 30–V–86, leg. T. Rodríguez (1). Constancia (29SND57, Abrantes), 31–V–86, leg. A. Outeiro (2).

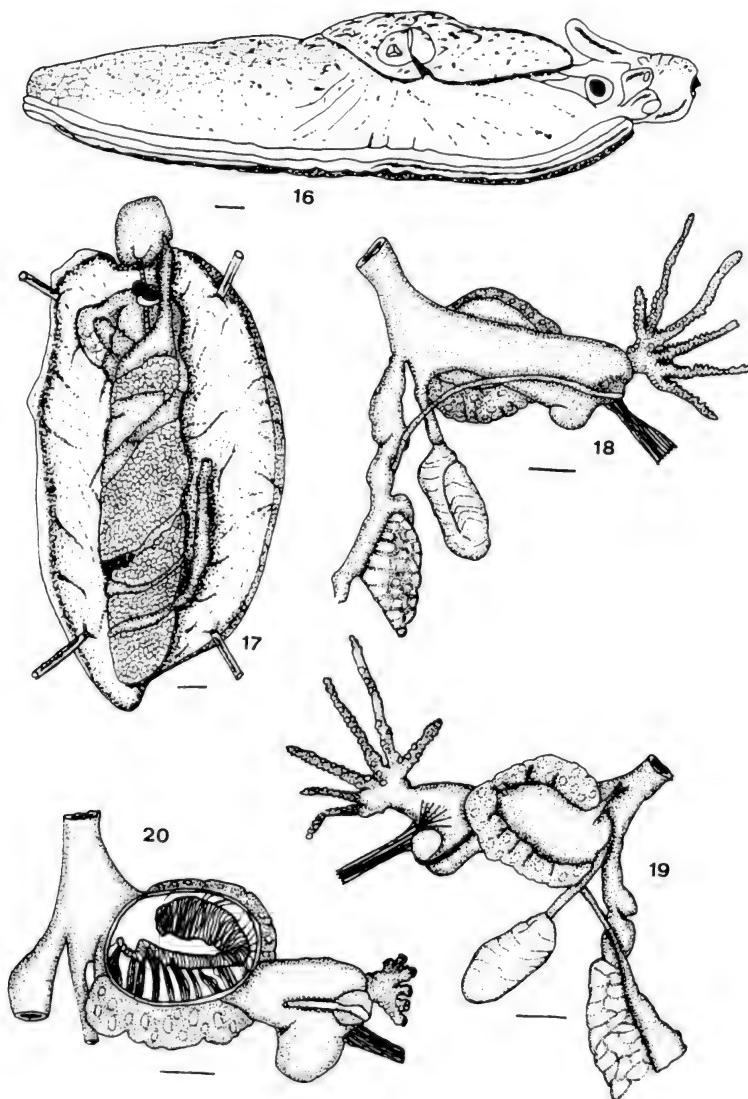
Specimens with horseshoe-shaped stimulators (= *D. lombricoides* (Morelet, 1845, Partim!)). Sameiro (29TNF59, Braga), 17-IV-83, leg. J. Castillejo (1). Covide (29TNG62, Gerês), 9-III-84, leg. J. Castillejo (7). São Bento da Porta Aberta (29TNG61, Gerês), 9-III-84, leg. T. Rodriguez (12). Pontefera (29TNG72, Gerês), 9-III-84, leg. A. Outeiro (6). Leonte (29TNG72, Gerês), 9-III-84, leg. T. Rodriguez (4). Portela do Home (29TNG72, Gerês), 9-III-84, leg. J. Castillejo (14). Feitos (29TNG20, Barcelos), 31-X-84, leg. A. Outeiro (2 Specs.). Pontefera (29TNG72, Gerês), 1-XI-84, leg. J. Castillejo (6). Viveiro das Trutas (29TNG72, Gerês), 1-XI-84, leg. T. Rodriguez (5). São Bento da Porta Aberta (29TNG61, Gerês), 1-XI-84, leg. A. Outeiro (2). Carvalhelhos (29TPG01, Chaves), 2-XI-84, leg. T. Rodriguez (7). Quintas (29TPG10, Chaves), 2-XI-84, leg. J. Castillejo (13). Pisoas (29TNG92, Montalegre), 2-XI-84, leg. A. Outeiro (2). Chaos (29TPE48, Guarda), 28-XI-84, leg. A. Outeiro (1). Sameiro (29TPE27, Serra da Estrela), 29-XI-84, leg. J. Castillejo (8). Manteigas (29TPE27, Serra da Estrela), 29-XI-84, leg. T. Rodriguez (7).

Discussion

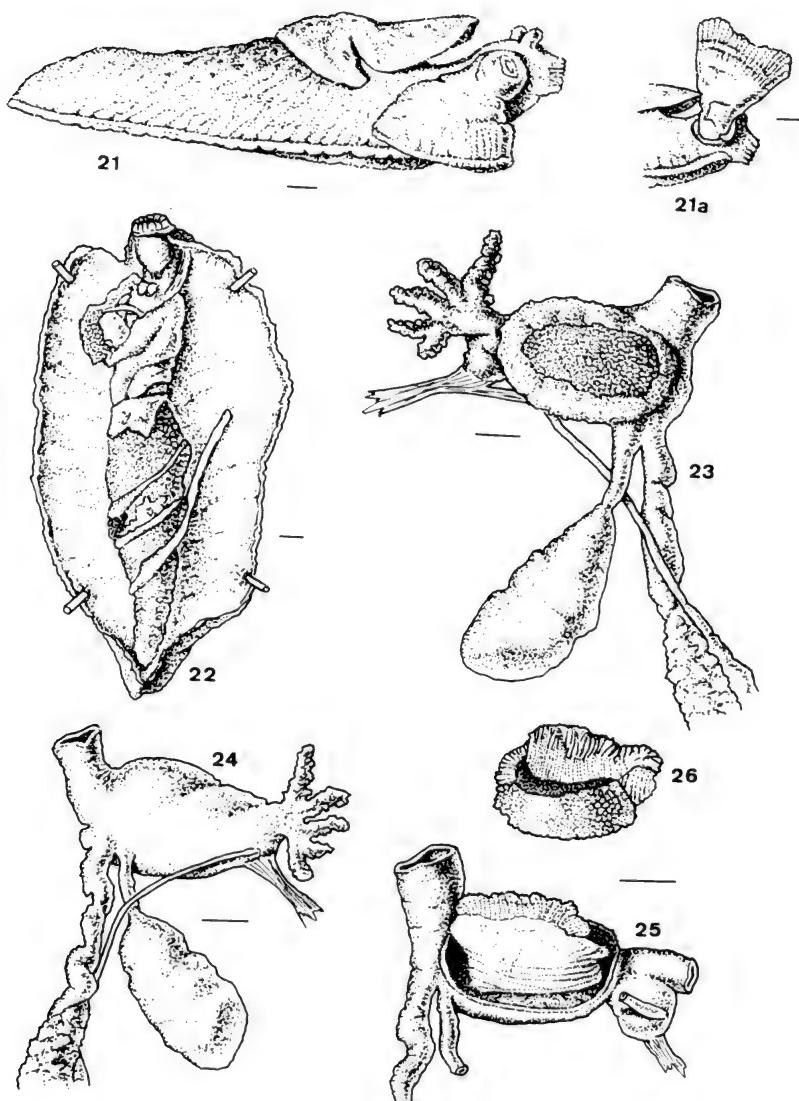
The material that we have examined shows that Portugal still has populations of *D. lombricoides* (Morelet, 1845) (as restricted by Simroth 1891). The stimulator is like a comb folded upon itself many times, and when extended adopts a horseshoe shape (Fig. 20). In these specimens the distal spheroid bulge is covered by a structure of glandular appearance which, like the stimulator, is horseshoe-shaped (Fig. 19). These populations were found in northern Portugal and in Guarda (Serra da Estrela). There are likewise still Portuguese populations in which all the individuals have stimulators in the form of flat folds as in *D. immaculatum* (Simroth, 1891) (Figs. 21, 21a). However, in both the Serra do Gerês and the Serra da Estrela, where most individuals have clearly horseshoe-shaped stimulators, we have also found specimens with the extremes of the horseshoe so slightly marked as to result in a curved fold intermediate between the typical horseshoe of *D. lombricoides* (Morelet, 1845) and the flat fold of *D. immaculatum* (Simroth, 1891). Furthermore, the copula of *D. immaculatum* appears to be identical to that of *D. lombricoides*: on December 10th 1985, in the Serra do Caramulo, we observed a mating pair whose stimulators were clearly flat folds like those of Figs. 25, 26, 29, 30, and whose mating postures and behaviour were identical to those described for *D. lombricoides* by Simroth (1891, Pl. 3, fig. XI). We therefore consider that *D. immaculatum* should be considered a synonym of *D. lombricoides* (Morelet, 1845) (as restricted by Simroth 1891). The specimens on which Castillejo *et al.* (1984) based their re-description of *D. lombricoides* in fact had stimulators with shapes closer to the *immaculatum* flat fold than to the typical *lombricoides* horseshoe.

In Luso and Abrantes, in the territory of a population with characteristics typical of *D. immaculatum* (Simroth, 1891), we found specimens in which the stimulator looked conical (like that of *D. nitidum* (Morelet, 1845)) because it projected towards the vagina (Figs. 27, 28), either because of intraspecific variation or due to contraction of the penial muscle upon death by asphyxia.

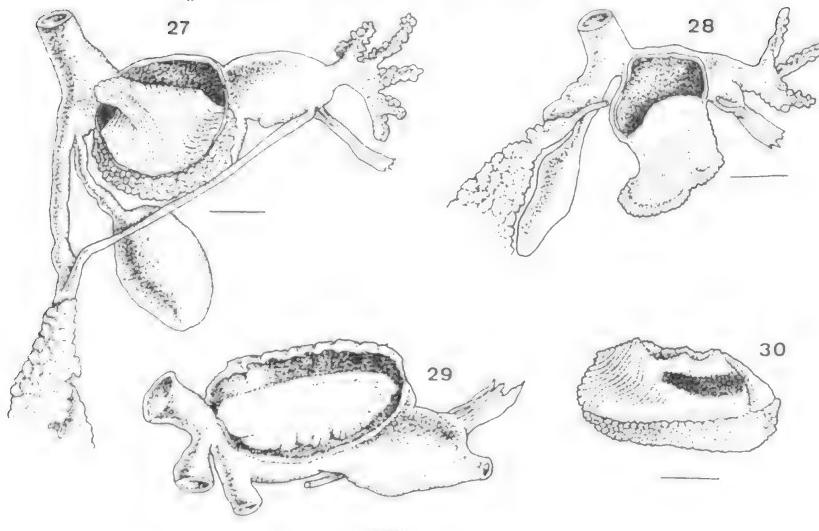
Finally, it should be pointed out that when Simroth drew the genitalia and the copulation of *D. lombricoides* (Simroth, 1891, Pl. 3, figs. XI-XVI) he confounded two species. Figs. XI, XV and XVI of his Plate 3 represent *D. lombricoides* (Morelet, 1845) (as restricted by Simroth 1891), and Figs. XII-XIV a completely different species which his own figures and text show to have a copulation quite unlike that of *D. lombricoides* and genitalia characterized by having two glandular masses and two stimulators (Simroth, 1891, pp. 285-286). We ourselves have found individuals of this latter kind that fit Simroth's description perfectly, and we have also observed their copulation, which is indeed totally different from that of *D. lombricoides* (Morelet, 1845); they are provisionally described below under the name *Deroceras* sp.



Figs. 16–20. *Deroceras lombricoides* (Morelet, 1845, Partim!).
Portela do Home (UTM 29TNG72). 16: side view. 17: organs *in situ*. 18 and 19: genitalia. 20: stimulator *in situ*.
Scale 1 mm.



Figs. 21–26. *Deroceras lombricoides* (Morelet, 1845, Partim!) (= *D. immaculatum* Simroth, 1891).
 21 and 21a: superior and inferior views of the evaginated stimulator of a specimen found copulating on December 10th 1985 in Pes de Pontes, Serra do Caramulo (UTM 29TNF70). 22–26: organs *in situ*, genitalia and stimulator of a specimen collected in Portunhos (UTM 29TNE35). Fig. 26 is the stimulator shown in Fig. 25 from a different angle.
 Scale 1 mm.

Figs. 27–30. *Deroceras lombricoides* (Morelet, 1845). Stimulators *in situ*.

27: Luso (UTM 29TNE57). 28 and 29: Constancia, Abrantes (UTM 29SND57). 30: another view of the stimulator of Fig. 29. Scale 1 mm.

***Deroceras hispaniensis* Castillejo et Wiktor, 1983**

Description

Length 35 mm live, 23–27 mm in 70° alcohol. Body dark chestnut with small dots on the back. Body and sole mucus colourless.

Genitalia (Figs. 34–37). Topography of the ovotestis, hermaphrodite duct, albumin gland and spermiduct typical of the genus. The penis comprises a globose distal part and a cylindrical proximal part with a dilation or caecum near the insertion of the retractor penis (Figs. 34, 35). Penial gland terminal, with two or three festooned branches, and of variable length (sometimes longer than the penis). The distal penis has a spheroid bulge capped by a glandular mass; the bulge may be joined to the anterior caecum by a band of muscle. The short vas deferens ends near the penial gland and the insertion of the retractor penis. Copulatory sac oval, with a short duct. Internal wall of the penis covered with minute longitudinal striae. Membranous, annular, thin-walled stimulator housed in the distal bulge (Figs. 32, 33, 36, 37). The interior disc of the annulus exhibits a coarsely striated triangular area leading to a minute orifice through which the glandular cap may perhaps expel its secretions into the interior penis; these striations are perpendicular to the fine striae covering the rest of the interior penis, and are most easily seen in specimens in which the distal penis is evaginated on death by asphyxia (Figs. 32, 33).

Material examined (Fig. 38).

Mirador de Sao Silvestre (29TNG11, Viana do Castelo), 15–XII–85, leg. A. Outeiro (2). Ponte de Lima (29TNG32, Viana do Castelo), 15–XII–85, leg. J. Castillejo (15). Sao Salvador da Torre (29TNG32, Viana do Castelo), 16–XII–85, leg. T. Rodríguez (2).

Discussion

Wiktor and Castillejo (1987) and Giusti (personal communication) considered that *D.*

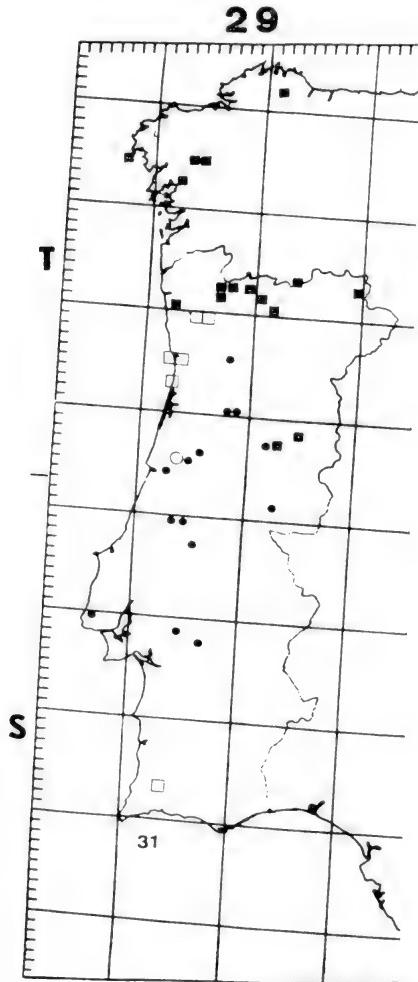
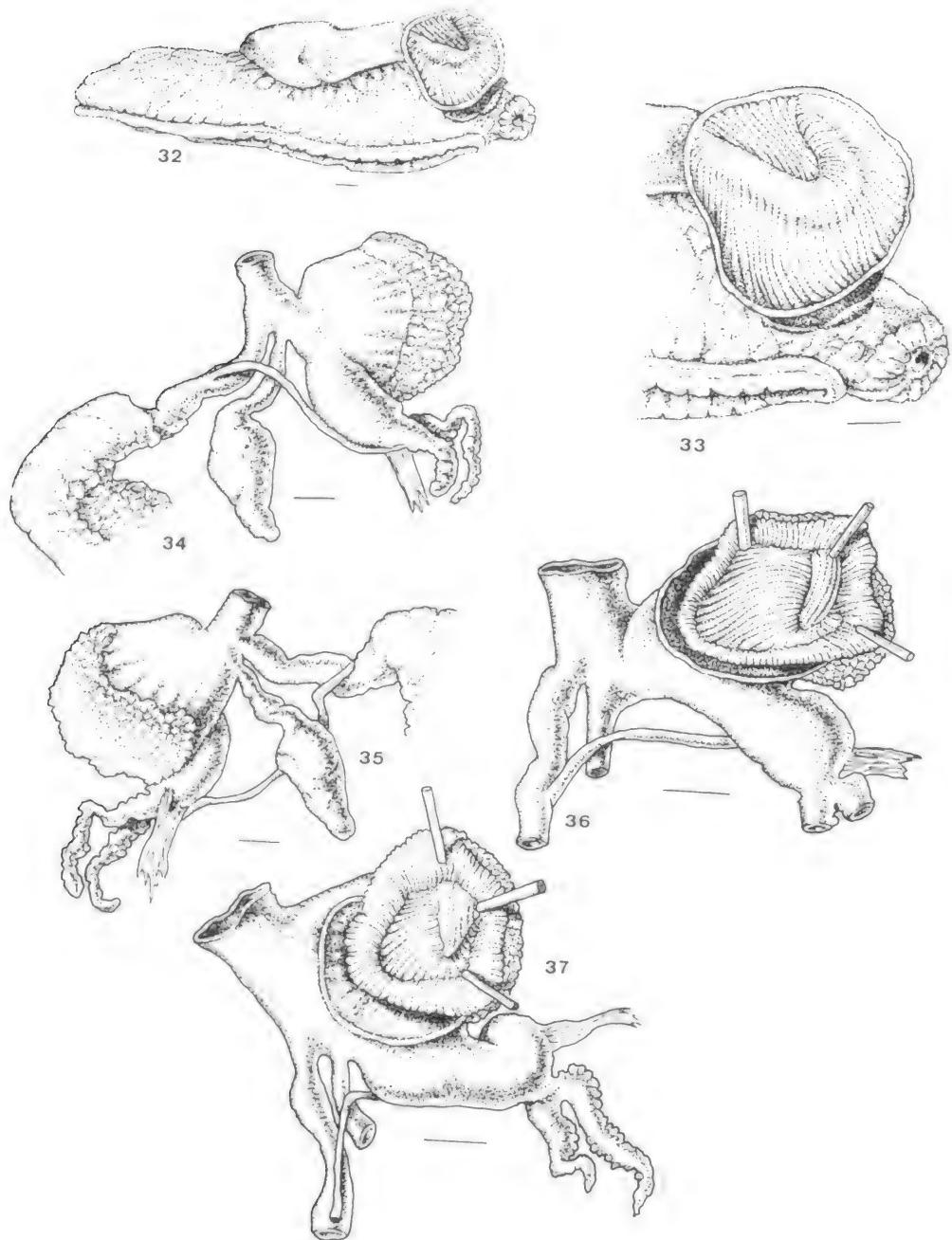


Fig. 31. Map of localities in which *Deroceras lombrocoides* (Morelet, 1845) and *Deroceras immaculatum* (Simroth, 1891) have been found.

■ Our findings of *D. lombrocoides*. ● Our findings of *D. immaculatum*. □ Findings of *D. lombrocoides* mentioned by Morelet and Simroth. ○ Findings of *D. immaculatum* mentioned by Morelet and Simroth. Scale 100 km.

immaculatum (Simroth, 1891), *D. lombrocoides* (Morelet, 1845) (as restricted by Simroth (1891)) and *D. hispaniensis* Castillejo et Wiktor, 1983 are probably all the same species. Though one of the present authors initially shared this opinion, examination of the additional specimens since captured has led us to the view that although these three forms are all similar as regards the external morphology of the penis, the morphology of their stimulators probably differentiates between *D. hispaniensis* on the one hand and *D. lombrocoides* (including *D. immaculatum*) on the other.



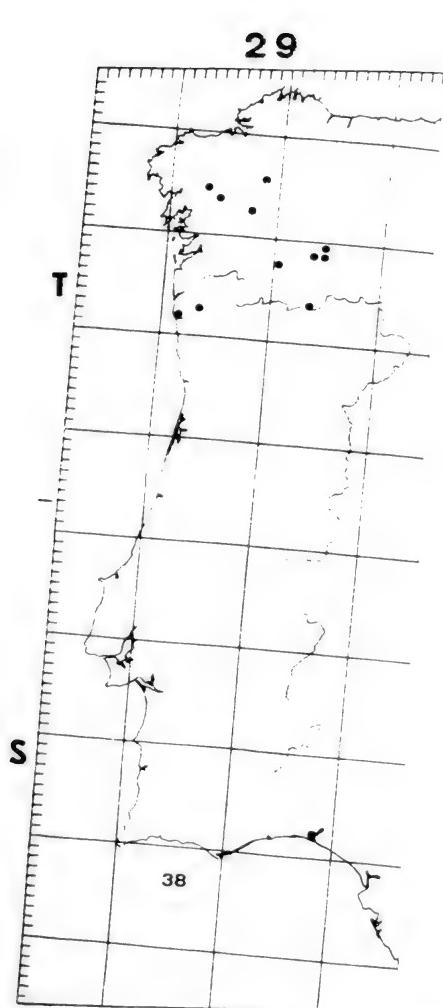


Fig. 38. Map of localities in which *Deroceras hispaniensis* Castillejo et Wiktor, 1983 has been found. Scale 100 km.
Fig. 39. Possible distributions of the group of species discussed in this article. Scale 100 km.

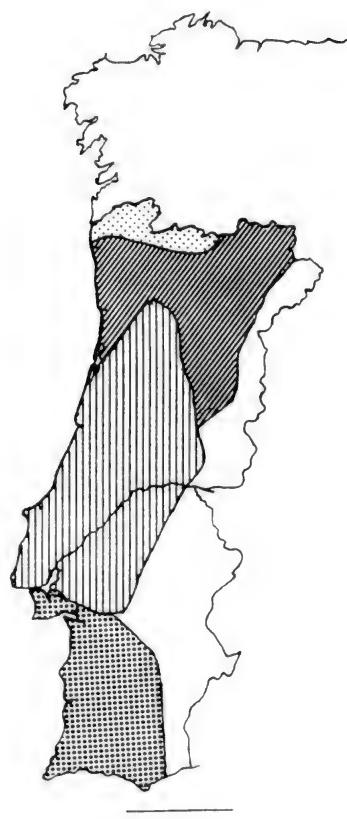


Fig. 39

	<i>D. hispaniensis</i>
	<i>D. lombricoides</i>
	<i>D. immaculatum</i>
	<i>D. nitidum</i>

Figs. 32–37. *Deroceras hispaniensis* Castillejo et Wiktor, 1983.

32: specimen from Ponte de Lima (UTM 29TNG32) with the evaginated stimulator forming a cup with a different kind of epithelium at the bottom. 33: a detail of the specimen of Fig. 32. 34 and 35: genitalia. 36 and 37: stimulators of two different specimens *in situ*. Scale 1 mm.

The evidence for the identity of *D. lombricoides* (Morelet, 1845) (as restricted by Simroth (1891)) and *D. immaculatum* (Simroth, 1891) is twofold. Firstly, in *D. lombricoides* populations in the Serra da Estrela and the Serra do Gerês, in which horseshoe-shaped stimulators predominate, there are also individuals possessing stimulators with a less pronounced U like a slightly curved flat fold. Secondly, the behaviour of the mating pair of *D. immaculatum* (Simroth, 1891) that was observed on December 10th 1985 in the Serra do Caramulo was identical to that described by Simroth (1891, Pl. 3, fig. XI) for *D. lombricoides* (Morelet, 1845). It is therefore reasonable to consider these two forms provisionally as constituting a single species in which the shape of the stimulator ranges from a flat fold to a pronounced horseshoe shape. At an earlier stage of this species' evolution, all its individuals may have flat fold stimulators, or they may all have had horseshoe-shaped stimulators.

Though extension of the same reasoning as above might suggest that the annular stimulators of *D. hispaniensis* are likewise within the range of intraspecific variation of *D. lombricoides* (Morelet, 1845) (as restricted by Simroth (1891)), another feature of internal genital anatomy must also be taken into account. In *D. lombricoides* (Morelet, 1845) and *D. immaculatum* (Simroth, 1891), the glandular mass capping the spheroid bulge of the penis appears to communicate with the interior of the penis via numerous filaments surrounding the stimulator, whereas in *D. hispaniensis* the two regions communicate via a well-defined tongue-shaped structure located within the stimulatory ring and exhibiting a different texture and coarser striation than other areas (Figs. 36, 37). Since we have furthermore never come across specimens with stimulators intermediate between the horseshoe of *D. lombricoides* (Morelet, 1845) and the annulus of *D. hispaniensis*, we provisionally consider that *D. hispaniensis* is a valid species. A definitive decision on the relationships among *D. hispaniensis*, *D. immaculatum* (Simroth, 1891) and *D. lombricoides* (Morelet, 1845) must await the study of characteristics such as enzyme forms.

Deroceras sp.

Synonyms: *Deroceras lombricoides* (Morelet, 1845, Partim!, Ex parte Simroth, 1891).

Description

Length 30 mm live, 22 mm in 70° alcohol (Figs. 40 and 41). Body brown, dark on the back and lighter on the flanks and neck. Epidermis with irregular darker punctiform mottling. Sole whitish, divided in three areas. Body mucus colourless.

Genitalia (Figs. 43–48). Topography of the hermaphrodite duct, albumin gland and spermiduct typical of the genus. In sexually mature specimens the ovotestis is composed of black acini. Proximal penis cylindrical, with a slight subterminal bulge. Penial gland terminal, divided in two or three branches of variable length with festooned borders. Distal penis thick, spheroid, with two more or less prominent structures of glandular appearance. Interior penial wall covered in fine longitudinal striae continuing into the spheroid bulge of the distal penis. The interior tectum of the posterior penis's spheroid mass features two tongue-shaped, more coarsely striated stimulators, the narrower part of each of which has an orifice communicating with the corresponding exterior glandular mass. Vas deferens short, of uniform cross-section, terminating near the penial gland and the insertion of the retractor penis. Retractor penis long, with one end inserted near the pallial complex and the other in the proximal penis, where the muscle branches towards the base of the posterior penis's spheroid mass. Copulatory sac oval, with a short duct. Oviduct free, as long or longer than the copulatory sac's duct. The two stimulators and the orifices by which the exterior glandular masses communicate with the interior penis can be clearly observed during copulation and when the penis is evaginated upon death by asphyxia. The stimulators are evident in sexually mature specimens, but immatures only exhibit two triangular areas with epithelial striation differing from that of the rest of the penis.

Material examined

Curral de Leonte (29TNG72, Serra do Gerês), 1–XI–84, leg. J. Castillejo, (19). Taipas (29TNF59, Guimaraes), 14–XII–85, leg. J. Castillejo, (6).

Discussion

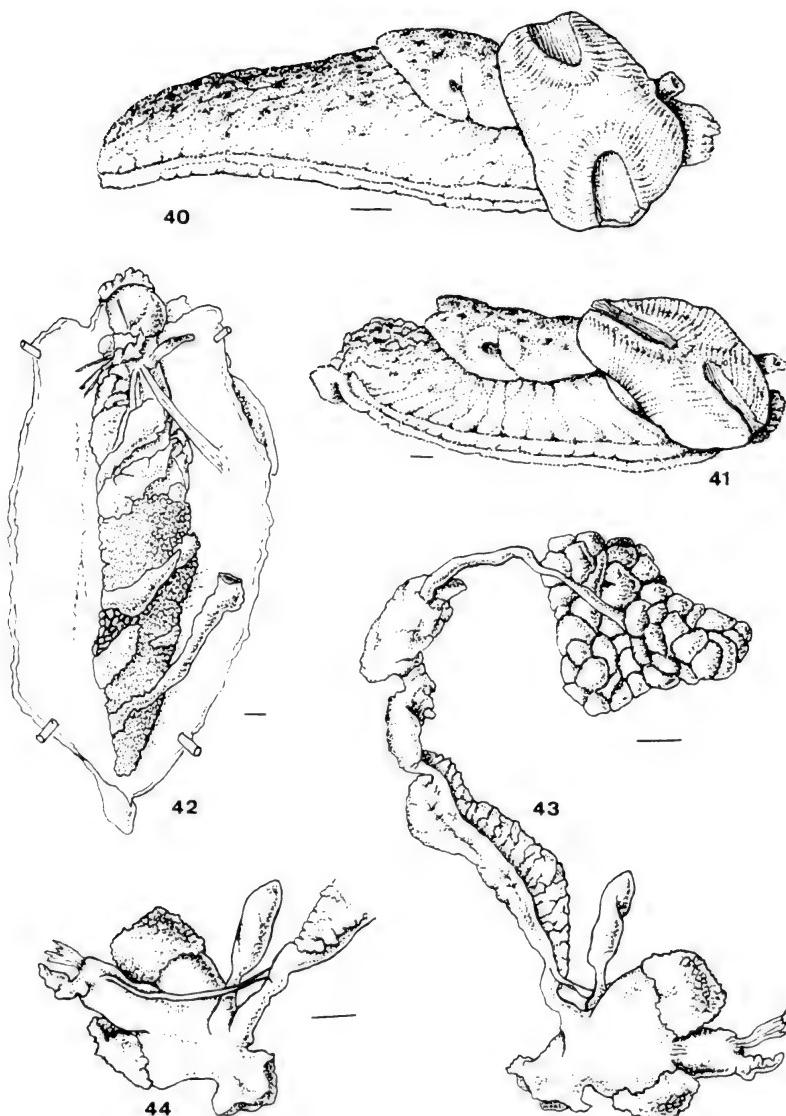
In describing the copulation of *D. lombricoides* (Morelet, 1845) (as restricted by Simroth (1891)), Simroth (1891) states that the mating pair take up positions next to each other forming a circle, and that they produce, from the genital orifice, a thick flat triangular stimulator which they place against the mate's back (Simroth, 1891, Pl. 3, fig. XI). Later, for another copulation observed in Oporto, he describes different behaviour in which the mating pair alternately circled round or kept still with the stimulator all the time pressed against the mate's flank. The copulation of this latter pair is illustrated (Simroth, 1891, Pl. 3, fig. XII), but not their genitalia. He refers to these figures when he mentions that on being placed in alcohol, one of the pair evaginated a kind of 'spoon', a structure that was convex outside and concave inside and whose apex featured epithelial formations that were clearly distinct from the rest of the evaginated organ. He naturally assumed these formations to be stimulators, and that they communicate with two whitish vesicles that could be seen during copulation.

Comparison of Simroth's illustrations with topotypes of *D. lombricoides* (Morelet, 1845) (as restricted by Simroth (1891)) that we have collected in the Serra do Gerês has convinced us that the series of illustrations that purport to represent the species (Simroth 1891, Pl. 3, figs. XI–XVI) in fact represent two quite different species. Figs. XI, XV, XVIa and XVIb do indeed show *D. lombricoides* (Morelet, 1845) (as restricted by Simroth (1891)), but Figs. XII–XIV show the different species whose penis was described by Simroth himself (1891, pp. 285–6) as having two glandular masses outside and two stimulators inside. It is this species that we provisionally refer to as *Deroceras* sp.

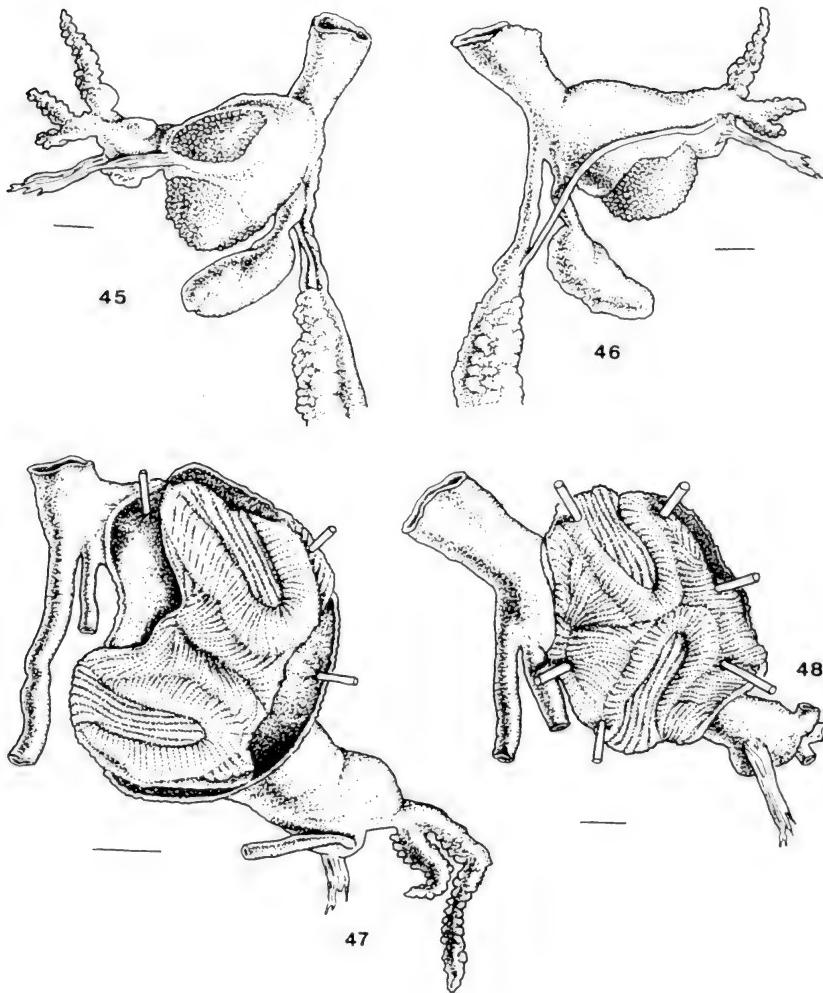
CONCLUSIONS

The group of species discussed here all have external coloration varying from light brown to black, colourless body mucus, a rectum with no caecum or with just a hint of one, a penis divided in a distal part with a spheroid bulge containing the stimulator(s) and a proximal part with a caecum and a penial gland that may be more or less ramified but is invariably festooned. Theoretically, it would be possible to subdivide this group on the basis of the shape of the stimulator, which is ring-shaped in *D. hispaniensis* Castillejo et Wiktor, 1983, horseshoe-shaped (with the gap facing the vagina) in *D. lombricoides* (Morelet, 1845) (as restricted by Simroth (1891)), a flat fold in *D. immaculatum* (Simroth, 1891) and a cone in *D. nitidum* (Morelet, 1845) (= *D. maltzani* (Simroth, 1885)). The problem resides in determining which anatomical characteristics are really valid for distinguishing between species. The current view that the stimulator is a specific determinant has led to many forms with identical penial topographies being separated because their stimulators are different. Indeed, this was Simroth's argument for separating his *D. immaculatum* from *D. lombricoides* (Morelet, 1845).

Our recent research has discovered forms that are intermediate between *D. immaculatum* (Simroth, 1891) and *D. lombricoides* (Morelet, 1845) but no intermediates between the latter and *D. hispaniensis* Castillejo & Wiktor, 1983. Though the possibility that all three jointly make up a single polytypical species with considerable intraspecific variation exists and is currently being investigated in our laboratory by determining the genetic distances among the three forms, we therefore provisionally consider *D. immaculatum* (Simroth, 1891) to be a



Figs. 40-44. *Deroceras* sp. 40 and 41: specimens with the posterior penis evaginated. 42: organs *in situ*. 43 and 44: dorsal and ventral views of the genitalia. Scale 1 mm.



Figs. 45-48. *Deroceras* sp. 45 and 46: dorsal and ventral views of the posterior genitalia. 47 and 48: interior distal penis, showing the two stimulators. Scale 1 mm.

synonym of *D. lombricoides* (Morelet, 1845) (as restricted by Simroth 1891), and that *D. hispaniensis* Castillejo et Wiktor, 1983 is a valid species. *D. maltzani* (Simroth, 1885) is clearly a later synonym of *D. nitidum* (Morelet, 1845), since the genitalia, the stimulators and the geographical distributions mentioned by Simroth (1891) are all identical.

With regard to the distributions of these forms, *D. nitidum* (Morelet, 1845) has only been found near the coast and then only south of the Tagus; *D. lombricoides* (Morelet, 1845) has been found with the stimulator in the shape of a flat fold in central and western Portugal and with a horseshoe-shaped stimulator in northern and western Portugal; *D. hispaniensis* Castillejo & Wiktor, 1983 has only been collected in northern Portugal, near the Luso-Spanish border; and *Deroceras* sp. appeared in the Costa Verde region.

ACKNOWLEDGEMENTS

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OBITUARY

BRUCE WILFRED SPARKS

Bruce Wilfred Sparks, who was born in London on 19th February, 1923 and died at Papworth Hospital, Cambridge on the 5th December, 1988, was a distinguished geomorphologist and investigator of Quaternary molluscs. After war service with the Royal Navy, he graduated in 1947 with first class honours in geography from University College, London. He briefly taught at Queen Mary College before moving in 1949 to the Department of Geography at Cambridge where he taught for over thirty years before taking early retirement due to failing health. He is remembered with gratitude and affection by numerous past students for his quiet scholarship, gentle humour, and devotion to teaching. His first book, *Geomorphology*, published in 1960, quickly became a standard reference work for students and has now passed through three editions. It was followed in 1971 by *Rocks and Relief*, which examined the by then rather unfashionable geological underpinnings of geomorphology. He also wrote with R. G. West *The Ice Age in Britain* (1972), which provided a stimulating overview of the complex environmental changes of the Quaternary.

Elected to a Fellowship of Jesus College, Cambridge in 1962, Bruce Sparks devoted much time to College administration. He was Steward from 1964 to 1970, and Senior Tutor from 1970 to 1982: roles which he greatly enjoyed and filled with distinction. His many hobbies included photography, listening to classical music, reading detective novels, cooking wild fungi, and in later years making furniture and wooden toys.

Bruce Sparks began to take a special interest in Quaternary molluscs from quite early in his academic career. He often visited Hugh Watson, the redoubtable Cambridge recluse, to discuss problems of identification and nomenclature, and he corresponded with many British and European experts. Although primarily concerned with fossil molluscs, he sometimes went collecting in the Cambridge district to add to his stock of reference specimens and to extend his knowledge of the ecological requirements of less familiar species. A quiet, self effacing man, he seems rarely to have attended the Society's meetings, and despite the importance of his work on fossil Mollusca, was probably little known personally by many of the present membership.

The first paper that Bruce Sparks wrote on fossil Mollusca appeared in the *Geological Magazine* in 1952, and described some periglacial and Post-glacial faunas in deposits at Barrington, Cambridgeshire. He had beginner's luck and was able to add a new fossil species to the British list: *Trochoidea geyeri* (Soós). In the following year he supplied an appendix on the fossil Mollusca to accompany a paper by D. Walker on the interglacial deposits at Histon Road, Cambridge. Later in the fifties, he began a long and fruitful research partnership with R. G. West investigating interglacial deposits in eastern and southern England. He was always a very painstaking researcher: from one site alone he extracted and identified 36,645 shells! By the close of his research career, he had written over 35 papers and reports on Quaternary Mollusca.

Bruce Sparks did much to place the study of Quaternary molluscs on a sound, modern footing. He soon realised that the pioneer work of A. S. Kennard badly needed updating because Kennard had a very confused perception of Quaternary stratigraphy, and often determined which species of mollusc were present in sediments by simple visual inspection in the field. Sparks showed that this informal method of sampling tended to result in an over-representation of large species and that smaller species were often missed. He was, therefore, always careful to collect bulk samples of sediment, which he would wash through sieves to retrieve the fossil shells. He also pioneered the construction of histograms to chart the changing fortunes of different species through Quaternary sequences. In reconstructing past

environments using Mollusca, he was much influenced by Boycott's papers on the present ecological requirements of British species.

Bruce Sparks had the good fortune to discover *Vallonia tenuilabris* (Al Braun) in a loamy layer in periglacial fan deposits at Little Chesterford, Cambridgeshire. There had been a few previous British records, but he was able to show that these were either erroneous or at the very least highly suspect. He recovered only 2 shells at Little Chesterford, despite sieving the equivalent of a small lorry load of loam to try to recover more. The *Vallonia* has never been recorded again in any British Quaternary deposit, although it is a not uncommon fossil in the Netherlands, and suggestions have sometimes been made that Sparks suffered a *lapsus crassus* and unwittingly allowed specimens of Continental origin from his reference collection to contaminate his Little Chesterford samples. However the shells he found were plugged with loam from the Little Chesterford deposits, and knowing how carefully he worked, both in the field and in the laboratory, I am sure that contamination can be ruled out, and that the species will be one day refound in a British Quaternary deposit.

One classic mistake that he made early in his research career and freely acknowledged concerned some supposedly Quaternary snails that a collector sent him from a desert area of the Middle East. He duly identified the shells, which were very dirty, and put them with labels into specimen tubes stopped up with corks. A year or so later he came to look at the shells again, and found the labels missing or in one case half eaten, and on placing the shells on wet blotting paper discovered to his chagrin that the Mollusca were not as fossil as he had been led to believe!

Bruce Sparks was forced to give up his work on molluscs in the late seventies because of failing eyesight, but his research has generated much new interest in Quaternary studies and fostered an increased awareness of the importance of fossil Mollusca. He entrusted nearly all his specimens from the various Quaternary sites that he investigated to the Sedgewick Museum, Cambridge, but his reference collection, which includes many gifts from Hans Schlesch, is presently in the writer's care at the University of Sussex. Conchology has lost an enthusiastic and very distinguished practitioner who will long be remembered for his many and varied research contributions. It was a privilege to have known him, and he will be greatly missed.

R. B. G. WILLIAMS

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JOURNAL OF CONCHOLOGY, VOL. 33, NO. 4

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OBITUARY

NORMAN ALEXANDER HOLME 1926–1989

Norman Holme ScD, MA, JP will be very much missed by his friends and colleagues both national and international, but by none more than those he leaves in the South-West.

He joined the staff of the Marine Biological Association after spending two years at the Laboratory as a student, straight from Cambridge. He studied the infauna between and below tidemarks, specialising in bivalve molluscs. His expertise and inventiveness in devising sampling gear – including a sledge-mounted television camera – is shown in *Methods for the study of marine Benthos* of which he was co-Editor with A. D. McIntyre. This sledge was shown in his illustrated talk to the Society in October 1989. During his 38 years with the MBA (he took early retirement in October 1987) he surveyed the benthos over most of the English Channel, producing a number of major papers on the subject. He wrote some 70 reports and papers, most of the latter appearing in the *Journal of the Marine Biological Association*, and most of them with some reference to molluscs.

The 'Torrey Canyon' oil-spillage disaster in 1967 heralded an involvement in the effects of oil and dispersants, and a strong commitment to marine conservation. He played a leading part in the designations of Voluntary Marine Conservation Areas in Devon (Wembury) and Cornwall (Roseland and Helford), being an indefatigable member of the various working groups. His network of contacts was prodigious and he was a great communicator – by letter or 'phone – and any query brought an immediate and practical response, no detail of organisation being too small for his concern, whether it was the presentation of a report, safety of personnel, fund-raising or publicity. As well as being a member of the Conchological Society which he joined in 1962, he had membership of the Malacological Society, 'Porcupine' and the Marine Conservation Society. For a number of years he was Chairman of the Devon and Cornwall Branch of the Institute of Biology and he was a keen supporter of the Devon Trust for Nature Conservation.

He was first taken seriously ill in 1986 during the preparation of the Helford River Survey Report, and despite his precipitous hospitalisation, he found time to make some last minute arrangements concerning the preparation of the Report. After major surgery and a remarkable recovery, he was again taken ill: in October 1988 he was told that he had only a few months expectation of life. He was concerned to lead as full and normal a life as possible, an aim with which Margaret, his wife, herself a marine biologist, wholly concurred. At this harrowing time, they were both supported by their children, Matthew, Sarah and Philippa. From then to within a week of his death on January 10th, he busied himself sorting his books and papers to ensure continuity of his work. His material on world-wide marine conservation, intended to appear in book form, has been placed in the hands of his former student, Keith Probert, now in New Zealand, whilst many other books, papers and slides were deposited with the Cornish Biological Records Unit at the Institute of Cornish Studies. The more local aspects of his conservation work are firmly established. Just one week before his death, Margaret read to him the foreword of the first Monitoring Report of the Helford VMCA, and obtained his approval. In our beginning is our end – it was in the Helford River that he had undertaken survey work in 1949 with his colleague Malcolm Spooner. It was with this same locality in his thoughts that this modest, gentle and unfeignedly enthusiastic man ended a life richly enjoyed and vividly remembered by his friends and colleagues. To his wife and children our Society will certainly wish to extend the most sincere sympathy.

Stella Maris Turk

JOURNAL OF CONCHOLOGY, VOL. 33, NO. 4

SCIENTIFIC PUBLICATIONS OF N. A. HOLME

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CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND, PROCEEDINGS

REPORT OF THE COUNCIL, 1988–1989

It is with regret that the society has to announce the deaths of the following members: Dr. N. Holme, a member since 1962 and Dr. van der Schalie, a life member since 1938. The death was also announced of Mr. B. Sparks, a former member.

The total membership of the Society now stands at 532, and is composed of the following categories: *Full members* 409, *Full Life Members* 30, *Family members* 31, *Family Life members* 6, *Junior members* 8, *Honorary members* 8, *Institutional members* 41. In addition there are 139 *Subscribers* who take out 147 subscriptions.

New members nominated and elected March 1988 – February 1989 *Full members* 14, *Family members* 2, *Institutional members* 2.

Transfers There was one transfer from *Full* to *Family* membership, and one transfer from *Junior* to *Full* membership.

Resignations *Full members* 10, *Junior members* 2.

Struck off for non-payment of subscriptions
Full members 17, *Junior members* 3, *Institutional member* 1.

Members ‘lost’ without addresses
Full members 1.

Meetings

There were seven Ordinary meetings and the Annual General Meeting held in the Demonstration Room of the British Museum (Natural History). A Marine Workshop was held at Mrs. J. Light's house in Godalming. A workshop on Quaternary non-marine Mollusca was held at the Department of Archaeology, University College, Cardiff.

Publications

Two parts of the *Journal of Conchology* were issued (Volume 33, parts 1 and 2). Four issues of the *Conchologists' Newsletter* were printed and issued with the Annual Programme Card of events. A membership list was issued in May 1988.

Subscribers

The total number of subscribers is 139 who took out a total of 147 subscriptions to the *Journal*. There were 10 subscribers to the *Conchologists' Newsletter* and *Papers for Students*.

Field Meetings

Six field meetings were held during 1988 – April 9th, Croydon. May 14th Amberley, West

PROCEEDINGS

Sussex. June 25th–26th Weymouth, Dorset. July 23rd Beachy Head and Willingdon, East Sussex. September 24–25th, Swanage, Dorset. October 8th, SE. Suffolk. Thanks are due to the following for leading these meetings – Miss Davies, Mr. Killeen, Mrs. Light, Mr. Palmer, and Dr. Willing.

MARY B. SEDDON
Hon. Secretary

RECORDER'S REPORT: MARINE MOLLUSCA

Much detailed information has come from several recorders, in particular from Mrs. J. Light (S15 Wight), Ms. W. Wright (S22 Cardigan Bay), Dr. I. D. Wallace (S24 Liverpool Bay), Dr. J. D. Nunn (several areas), Dr. S. M. Smith (several areas). Notable records are:

S15 Wight: *Onoba aculeus* (Gould) living in a lagoon at Pagham Harbour, Miss J. Barton, (see the comment in my last report – *J. Conch. Lond.*, **33**, p. 104); *Ammonicera rota* (Forbes and Hanley) living at Colwell Bay, IOW, and *Tornus subcarinatus* (Montagu) living off Hanover Point, IOW, Mrs. J. Light, (there are very few satisfactory live reports of either, but they are no doubt under-recorded); *Aeolidiella alderi* (Cocks) living in the Medina estuary, IOW, Roger Herbert, (an easterly extension of range of this southern species which is recorded from both shores of the western Channel and from west Ireland; the S29 record in the *Atlas* has been withdrawn).

S21 Bristol Channel: *Jordaniella (Odostomia) nivosa* (Montagu), *Jordaniella (Odostomia) truncatula* (Jeffreys), *Rhomboidella (Crenella) prideauxi* (Leach), all shells from Broadhaven, Dyfed, and *Odostomia acuta* Jeffreys, shells from Tenby, Dyfed, all Shelagh Smith; *Odostomia turrita* Hanley, living near Martin's Haven, Dyfed, Julia Nunn; (these are new to the Sea Area, or confirmation and updates of old records, of species for which there are few reports).

Publication by the Marine Conservation Society of a checklist for most marine phyla provides a list by Dr. S. M. Smith of British and Irish marine molluscs using up-to-date nomenclature which should be widely acceptable (S. M. Smith in C. Howson, (1987), *Directory of the British Marine Fauna and Flora*). I shall be using this list in future, but with reference to the name used in the *Sea Area Atlas* where different.

An update of the 1982 *Sea Area Atlas* is nearing completion and should be ready within a year, providing many additions and amendments, and widening the area covered to include adjacent Continental waters and shores from Bergen to Brest (not including the Baltic). For the added area, I am grateful to several correspondents who have gone to considerable trouble to abstract information and add to existing lists, particularly Jorgen Knudsen (Denmark), Dick Hoeksema, Joop de Ligt and Roeloff van Urk (Holland), Thierry Backeljau (Belgium and southern North Sea) and J. M. Dewarumez (Wimereux and east Channel). Much information on deep water species from west of Scotland and Ireland has come from Dr. J. D. Gage, Robin Harvey and Jeremy Colman from the surveys by Scottish Marine Biological Association. Monitoring by the Oil Pollution Research Unit of the effect of oil and gas platforms in the North Sea has greatly improved knowledge in that area.

It is sad to report the death of Dr. Norman Holme, Area Representative for sea area 40 (Labadie), who will be remembered in a marine recording context particularly for his work on the benthos of the English Channel.

D. R. SEAWARD

The following new vice-comital records have been authenticated since the last Report (*J. Conch., Lond.* 33, p. 104). All date from 1988 unless stated otherwise.

- Devon South (3): *Lymnaea stagnalis*, Exminster (20/9588), 1986; *Boettgerilla pallens*, Silverton (21/9607), both D. E. Bolton.
- Devon North (4): *Lymnaea glabra*, West Brushford (21/6607); *Boettgerilla pallens*, North Tawton (21/6802), both D. E. Bolton.
- Essex North (19): *Menetus dilatatus*, Waltham Abbey (52/3801), C. W. Plant, 1986.
- Buckingham (24): *Cochlicella acuta*, West Wycombe (41/8195), C. J. Smith.
- Norfolk West (28): *Deroceras caruanae*, Holkham (53/8844), R. C. Preece.
- Bedford (30): *Arion flagellus*, Toddington (52/0030), Mrs E. B. Rands.
- Northampton (32): *Vertigo mouliniana*, Sutton Bog (53/0800), A. P. Fowles.
- Radnor (43): *Anodonta anatina*, R. Ithon, Bailey Einion (32/0861), A. P. Fowles.
- Cardigan (46): *Limax flavus*, Aberystwyth (22/5781), A. O. Chater.
- Flint (51): *Vertigo substriata*, Northop (33/2468), P. Tattersfield, 1983; *Arion flagellus*, Wepre Woods (33/26), Mrs N. F. McMillan.
- Leicester (55): *Zonitoides excavatus*, near Leicester (43/50; site details currently confidential).
- Lancaster South (59): *Succinea putris*, *Limax cinereoniger*, Dean Wood, Upholland (34/5306), C. Felton.
- Linlithgow (84): *Boettgerilla pallens*, Linlithgow (36/0177), A. T. Sumner, 1987.
- Perth Mid (88): *Planorbis carinatus*, *Gyraulus laevis*, Fincastle Loch (27/8762), B. Verdcourt.
- Easterness (96): *Vertigo pusilla*, Reelig Glen (28/5540), Mrs D. K. Marriott.
- Westerness (97): *Acicula fusca*, Drimnin, Morvern (17/5652), Mrs D. K. Marriott.
- Ebudes Mid (103): *Deroceras caruanae*, Iona (17/2824), R. C. Preece.
- Ebudes North (104): *Arion flagellus*, Canna (18/20), Glasgow Museum.

A few of the above deserve comment:

Lymnaea glabra (v.c. 4). A species rather surprisingly not hitherto reliably reported from Devon, though not uncommon in parts of Cornwall.

Menetus dilatatus (v.c. 19). A North American planorbid no doubt introduced into the Lea valley, as elsewhere in Britain. At Waltham Abbey it occurs in a large canalised stream on the R. Lea floodplain.

Vertigo pusilla (v.c. 96). Reelig Glen is a significant addition to the few widely scattered sites known for this species in Scotland and confirms an unpublished record of 1943 by Mr A. R. Waterston at Easter Moniack in the same 10-km square. The habitat at Reelig Glen is a calcareous scree at the foot of a cliff.

Vertigo mouliniana (v.c. 32). This is the first living record from the East Midlands, an area from which only Postglacial fossils were previously known. Sutton Bog, an SSSI, is a valley fen fed by calcareous springs.

Arion flagellus (= *A. lusitanicus*, *sensu* Quick, *non* Mabille) (v.c.s 30, 51, 104). It is becoming clear that this large *Arion* is locally common in Britain, especially in the west. There are now Census authentications for the following vice-counties: 1-5, 14, 17, 21, 30, 33, 41, 45, 46, 48, 49, 51, 56, 58, 59, 64, 66, 69, 71, 77, 83, 97, 104, 105, 109, H3, H29, H35. The true *Arion lusitanicus* Mabille is evidently much scarcer, and has been confirmed only from v.c.s. 1, 3, 4, 15-17, 30, 38, 77, H3, H19. Stella Davies has checked most of these determinations.

Limax cinereoniger (v.c. 59). The country around Liverpool has been searched by generations of conchologists and though suitable habitats are few it is remarkable that this old woodland slug has escaped detection for so long. Dean Wood, Upholland, is a deciduous valley wood

PROCEEDINGS

along a stream and is likely to be of ancient origin.

Cochlicella acuta (v.c. 24). A flourishing colony of this maritime helcid, no doubt a recent accidental introduction. The habitat is south-facing chalk grassland, dominated by *Festuca* (see *Conchologists' Newsletter* no. 109, p. 196). Similar colonies have been reported inland from time to time elsewhere in southern England but rarely survive for long.

M. P. KERNEY

COMMUNICATIONS

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

Applications published in the Bulletin of Zoological Nomenclature

Comment or advice on these applications is invited for publication in the *Bulletin* and should be sent to the Executive Secretary, I.C.Z.N., British Museum (Natural History), Cromwell Road, London, SW7 5BD, U.K.

The following application was published on 16 December 1988 in Vol. 45, Part 4 of the *Bulletin of Zoological Nomenclature*.

Case 2643

Iphinoe Bate, 1856 (Crustacea, Cumacea): proposed conservation

M. Bacescu, Muzeul National de Istorie Naturală 'Grigore Antipa', Sos. Kisseleff 1, Bucureşti 79744, Romania. L. B. Holthuis, Rijksmuseum van Natuurlijke Historie, Postbus 9517, 2300 RA Leiden, The Netherlands.

Abstract. The purpose of this application is the conservation of the generic name *Iphinoe* Bate, 1856, of cumacean crustaceans by the suppression of the unused senior homonym *Iphinoe* Rafinesque, 1815 (Arachnoidea) and also the senior homonym *Iphinoe* H. & A. Adams, 1854, which is in occasional use for a restricted genus of gastropod.

The following application was published on 29 March 1989 in Vol. 46, Part 1 of the *Bulletin of Zoological Nomenclature*.

Case 2668

Drepanites Mojsisovics, 1893 and *Hyphoplites* Spath, 1922 (Mollusca, Cephalopoda): proposed conservation.

Earle E. Spamer & Arthur E. Bogan, Department of Malacology, Academy of Natural Sciences, 19th and the Parkway, Philadelphia, PA 19103, U.S.A.

Abstract. The purpose of this application is, by the suppression of the unused generic name *Drepanites* Bennett, 1831, to conserve its junior homonym *Drepanites* Mojsisovics, 1893 and also its junior subjective synonym *Hyphoplites* Spath, 1922, each being the name of a Mesozoic ammonite genus.

The following applications were published on 23 June 1989 in Vol. 46, Part 2 of the *Bulletin of Zoological Nomenclature*.

Case 2403

Valanginites Sayn in Kilian, 1910 (Cephalopoda, Ammonoidea): confirmation of the author of the genus, and of *Ammonites nucleus* Roemer, 1841 as its type species.

P. F. Rawson, Department of Geological Sciences, University College London, Gower Street, London, WC1E 6BT, U.K. E. Kemper, Bundesanstalt für Geowissenschaften und Rohstoffe, Postfach 510153, 3000 Hannover 51, Federal Republic of Germany.

Abstract. The purpose of this application is to confirm Sayn in Kilian, 1910 as the author of the Cretaceous ammonite genus *Valanginites*, and current usage of *Ammonites nucleus* Roemer, 1841 as its type species, although the specific name was first introduced by Phillips in 1829.

Case 2642

POLYGYRIDAE Pilsbry, 1894 (Mollusca, Gastropoda): proposed precedence over *MESODONTIDAE* Tryon, 1866.

K. C. Emberton, Department of Malacology, Academy of Natural Sciences, 19th and the Parkway, Philadelphia, PA 19103, U.S.A.

Abstract. The purpose of this application is to conserve the established family-group name *POLYGYRIDAE* Pilsbry, 1894 for a family of terrestrial pulmonates, by giving it precedence over the senior name *MESODONTIDAE* Tryon, 1866, a name which has only been used as valid by one author.

COMMUNICATIONS

Opinions published in the Bulletin of Zoological Nomenclature

The following Opinions were published on 23 June 1989 in Vol. 46, Part 1 of the *Bulletin of Zoological Nomenclature*.

Opinion 1539

Conus floridanus Gabb, 1869 (Mollusca, Gastropoda): not to be given precedence over *Conus anabathrum* Crosse, 1865.

Opinion 1540

Avicula gryphaeoides J. de C. Sowerby, 1836 (Mollusca, Bivalvia): specific name conserved.

The following Opinions were published on 29 March 1989 in Vol. 46, Part 3 of the *Bulletin of Zoological Nomenclature*.

Opinion 1518

Harpa articulata Lamarck, 1822 (Mollusca, Gastropoda): specific name conserved.

Opinion 1519

Ammonites neubergicus Hauer, 1858 (Cephalopoda, Ammonoidea): to be given precedence over *Ammonites chrisna* Forbes, 1846.

CALL FOR NOMINATIONS FOR NEW MEMBERS OF THE INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

The following members of the Commission reach the end of their terms of service at the close of the XXIV General Assembly of the International Union of Biological Sciences to be held in Amsterdam, in July 1991: Dr H. G. Cogger (Australia, Herpetology); Prof. Dr O. Kraus (Fed. Rep. Germany, Arachnology); Dr M. Mroczkowski (Poland, Coleoptera); Dr W. D. L. Ride (Australia, Mammalia). A further vacancy arises from resignation of Dr G. C. Gruchy (Canada, Ichthyology).

The addresses and specialist fields of the present members of the Commission may be found in the *Bulletin of Zoological Nomenclature*, 46(1) (March 1989). Under Article 3b of the Commission's Constitution a member whose term of service has terminated is not eligible for immediate re-election unless the Council of the Commission has decided to the contrary.

The Commission now invites nominations, by any person or institution, of candidates for membership. Article 2b of the Constitution prescribes that:

'The members of the Commission shall be eminent scientists, irrespective of nationality, with a distinguished record in any branch of zoology, who are known to have an interest in zoological nomenclature'.

(It should be noted that 'zoology' here includes the applied biological sciences (medicine, agriculture, etc.) which use zoological names).

Nominations made since September 1987 will be reconsidered automatically and need not be repeated. Additional nominations, giving the date of birth, nationality and qualifications (by the criteria mentioned above) of each candidate should be sent by 15 June 1990 to: *The Executive Secretary, International Commission on Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London SW7 5BD, U.K.*

TORNUS UNISULCATUS IN THE NORTH SEA

The very small gastropod *Tornus unisulcatus* Chaster has proved elusive in British waters since it was first described by George W. Chaster (as *Adeorbis unisulcatus*) in the *Journal of Conchology* in 1897 (*J. Conch., Lond.*, 8 (1897) p. 373). Chaster wrote: 'Two dead specimens were dredged off Rue Point, Rathlin Island, in seventeen fathoms. I have it also from Oban, Roundstone, Plymouth (where it is not very rare) and Tangier'. These records coincide with the data given in the *Sea Area Atlas of the Marine Molluscs of Britain and Ireland* (Seaward, D. R. (Ed.), 1982).

More recently, in 1974, *T. unisulcatus* is reported by Babio and Thiriot-Quiévreux in the region of Roscoff, Brittany and their paper includes excellent SEM photographs of the protoconch and of the whole shell, showing the open umbilicus, the angulated whorls and the characteristic sulcus which runs just below the periphery (*Cah. de Biol. Marine*, 15 (1974) pp. 531–549). There appear to have been no previous records of this species from the North Sea.

In April 1987 I took a sample of shell sand from Sandham Bay, Holy Island (Lindisfarne) on the Northumberland coast (map ref. NU 135436). In this sample was found a single empty shell of *T. unisulcatus*. The species is very small, this specimen having a diameter of about 0.62 mm compared with Chaster's which is given as 0.8 mm. Subsequently, in May 1988, a second, smaller specimen was found at the same location and in June 1989 a third specimen was discovered in shell sand taken in Balnakeil Bay near Durness in Scotland (map ref. NC 391687).

I am greatly indebted to Professor Alastair Graham of the University of Reading who has confirmed my

JOURNAL OF CONCHOLOGY, VOL. 33, NO. 4

identification of the first specimen, to Dr. J. J. van Aartsen who supplied the reference to the paper of Babio and Thiriot-Quiévreux and to Mr. Dennis R. Seaward for the reference to Chaster's original paper.

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**CAECUM ARMORICUM (PROSOBRANCHIA: RISSOACEA)
NEW TO THE BRITISH MARINE FAUNA**

I have previously described (*J. Conch., Lond.*, **32** (1987) p. 387) micro-habitats in the Fleet in Dorset in which the small bivalve *Lasaea rubra* (Montagu) var. *pallida* is common to abundant where sea water, which has presumably percolated from Lyme Bay through the shingle of Chesil Beach, seeps out from the stable shingle in many places and flows over the shore into the sheltered saline Fleet lagoon. These 'springs' occur both at the east end of the Fleet near its narrow outlet into Portland Harbour at Smallmouth where the tidal range is two metres or less, and also further west half way along the Fleet where the water is very shallow and the tidal range is a few centimetres. In both cases, the *Lasaea* is a member of a community living a few centimetres deep in the shingle interstices kept clear by percolating water; elsewhere these spaces are generally filled with sticky mud with little or no infauna.

When I discovered the mid-Fleet springs community during 1987, I found that it consisted almost entirely of three mollusc species: the *Lasaea* (abundant), a caecid and a rissoid *Onoba aculeus* (Gould) (both frequent), together with the bryozoans *Electra monostachys* (Busk) and *Bowerbankia* sp. Although rather similar to *Caecum glabrum* (Montagu), the caecid did not conform with any of the recognised British species, including *C. clarkii* Carpenter which occurs in the Channel Islands (see Hoeksema & Hoenselaar, *Basteria* **48** (1984) pp. 27–30) and which I suspect will turn up in southern England. However, it agreed well with the illustrations of *C. armoricum* De Folin, 1869 in a paper by Van Aartsen, Menkhorst and Gittenberger (*Basteria*, suppl. 2 (1984) fig. 121), and with the description and figures by Van Aartsen and Hoenselaar in *Basteria* **48** (1984) pp. 23–26. I sent specimens to Dr. Van Aartsen and he has confirmed this identification.

The species *C. armoricum* was described from specimens (apparently shells only) from St. Malo and the mouth of the Rhone, and shells had subsequently been found at five more sites extending the range south along the Atlantic coast to Portugal (Van Aartsen and Hoenselaar, *loc. cit.*). Thus the Fleet colony represents a further extension of range, the first and only known live records, and an addition to the British marine molluscan fauna. Specimens have been deposited in the British Museum (Natural History), accession number 1988074. All three species have so far been found to occur in springs along about 2 km of mid-Fleet shore. Adult *C. armoricum* have always been present when looked for in every month from April to October and December, with juveniles in June.

Spring sites in the east Fleet are different in character with more mollusc species and other phyla present, and although *Lasaea* is usually common and *Onoba* occasional to frequent, only a few shells and one living specimen of *Caecum armoricum* have been found there. The Fleet (Sea Area 16 Portland; 30(SY)67; 50°38'N, 2°34'W) is a private nature reserve, a Ramsar site and an SSSI.

I am grateful to Dr. Van Aartsen for confirming the identification of *C. armoricum*, and to him and Mr. H. J. Hoenselaar for further information and helpful discussion.

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(Received, 28th March, 1989)

INSTRUCTIONS TO AUTHORS

Manuscripts should be sent to:— **Dr M. P. Kerney, Department of Geology, Imperial College, London SW7 2BP.**

PAPERS Two copies of text and illustrations should be submitted; one set of illustrations must be good quality originals. Authors should refer to recent copies of the *Journal* for a guide to format. Authors are reminded of the high cost of printing and therefore are expected to write concisely and to make maximum use of page size when designing art-work and tables.

COMMUNICATIONS These are intended to be short notes of an original nature which do not merit the treatment of a full paper. *Communications* must not contain any figures, tables or plates and should conform in style to that of recent issues of the *Journal*.

Proposed fourth edition of the International Code of Zoological Nomenclature – a call for possible amendments to the third (1985) edition

The International Commission on Zoological Nomenclature has embarked on the preparation of a new (fourth) edition of the Code and has established an Editorial Committee for that purpose. It is expected that publication will be in late 1994 or in 1995. A considerable number of possible amendments to the Code have been suggested and these will be examined by the Editorial Committee. The Commission invites the submission of further possible amendments to the current (1985) Code and these should be sent as soon as possible to the Executive Secretary, I.C.Z.N., British Museum (Natural History), Cromwell Road, London SW7 5BD, U.K. It is intended that proposals received by the end of 1989 will be discussed at meetings held in conjunction with the International Congress of Systematic and Evolutionary Biology (ICSEB) in Maryland in July, 1990.

Official Lists and Indexes of Names and Works in Zoology – Supplement

The *Official Lists and Indexes* was published in 1987. This gave all the names and works on which the International Commission on Zoological Nomenclature had ruled since it was set up in 1895 up to December 1985. There were about 9,900 entries. In the three years since 1985, 544 names and 3 works have been added to the *Official Lists and Indexes*. A supplement has been prepared giving these additional entries, together with some amendments to entries in the 1987 volume. This supplement can be obtained without charge from the following addresses, from which the *Official Lists and Indexes* can be ordered at the price shown:

The International Trust for Zoological Nomenclature, British Museum (Natural History), Cromwell Road, London SW7 5BD, U.K. – Price £60 or \$110
or

The American Association for Zoological Nomenclature, c/o NHB Stop 163, National Museum of Natural History, Washington DC 20560, U.S.A. – Price \$110 (\$100 to A.A.Z.N. members).

Journal of Conchology

Vol. 33, Part 4, December 1989

Contents

	PAGE
PAPERS	
R. VON COSEL—Three new Species of <i>Solen</i> (Bivalvia: Solenidae) from the Indian Ocean, with Remarks on the Solenidae of Madagascar	189
J.-M. POUTIERS—Note sur le Genre <i>Daorvium</i> Torell, 1859 dans l'Océan Indien (Mollusques Bivalves: Mytilidae), avec Description de deux Espèces nouvelles	206
A. WARREN—Designation of Neotypes of <i>Melanella alba</i> (Da Costa, 1778) and <i>Fulma glabra</i> (D'A Costa, 1778) (Prosobranchia)	219
G. ETTLE, D. MORRITT, D. R. SEAWARD and G. A. WILLIAMS—Distribution of intertidal Molluscs in Lagoonal Shingle (The Fleet, Dorset, U.K.)	223
J. CASTRO, J. I. RODRIGUEZ and A. QUINTERO—Portuguese Slugs II. <i>Dermatophora</i> and the <i>Doridens limbatus</i> Group of Fornis (Gastropoda: Pulmonata: Agriolimacidae)	223
COMMUNICATIONS	
International Commission on Zoological Nomenclature	266
L. E. PHILSON— <i>Tonic musculi</i> in the North Sea	267
D. R. SEAWARD—Cochlidiodontina: Prosobranchia: Rissoidea: New to the British marine Fauna	268
OBITUARIES	
Proceedings	269

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Members are requested to notify the Hon. Secretary promptly of any change of address.